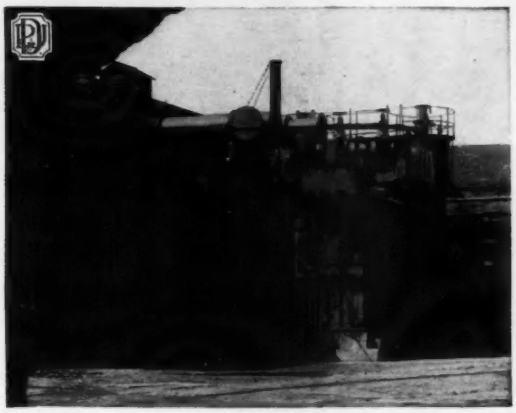
TECHNOLOGY DEPT.

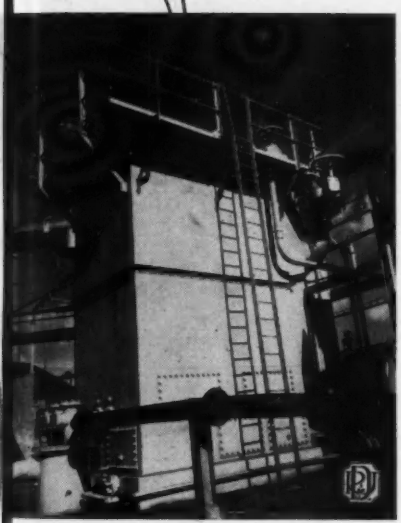
Gas Journal

VOL. 290. 109th YEAR. LONDON, APRIL 10, 1957. No. 4891. PRICE 1/6

GASHOLDERS



GAS WASHING PLANT



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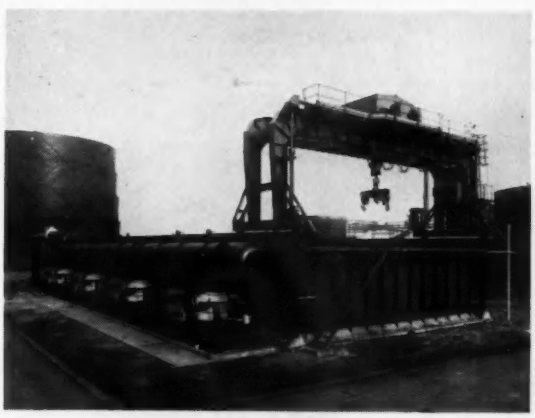

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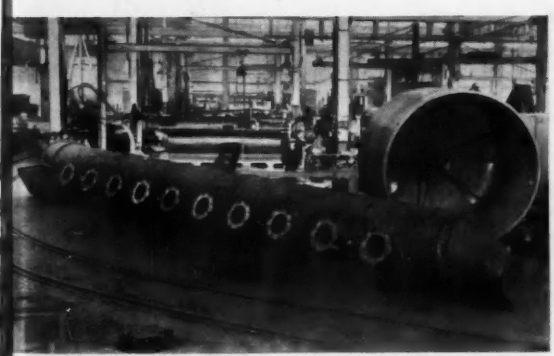

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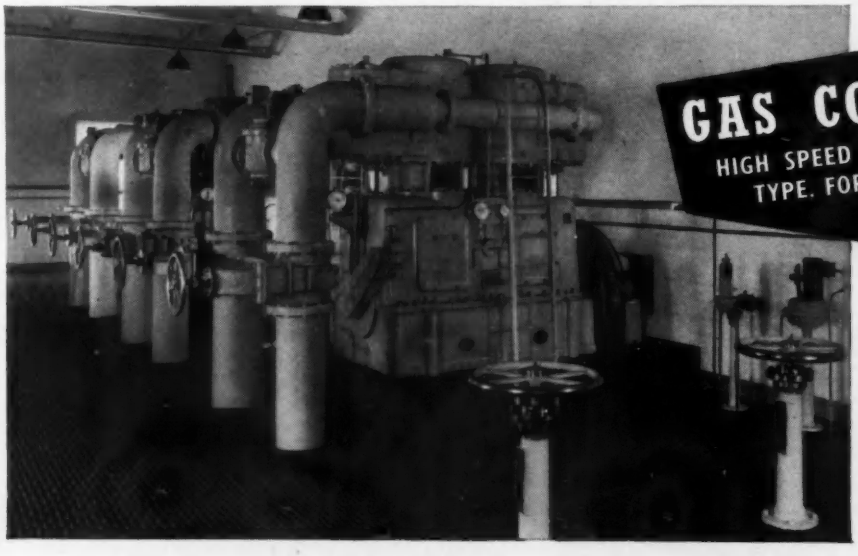

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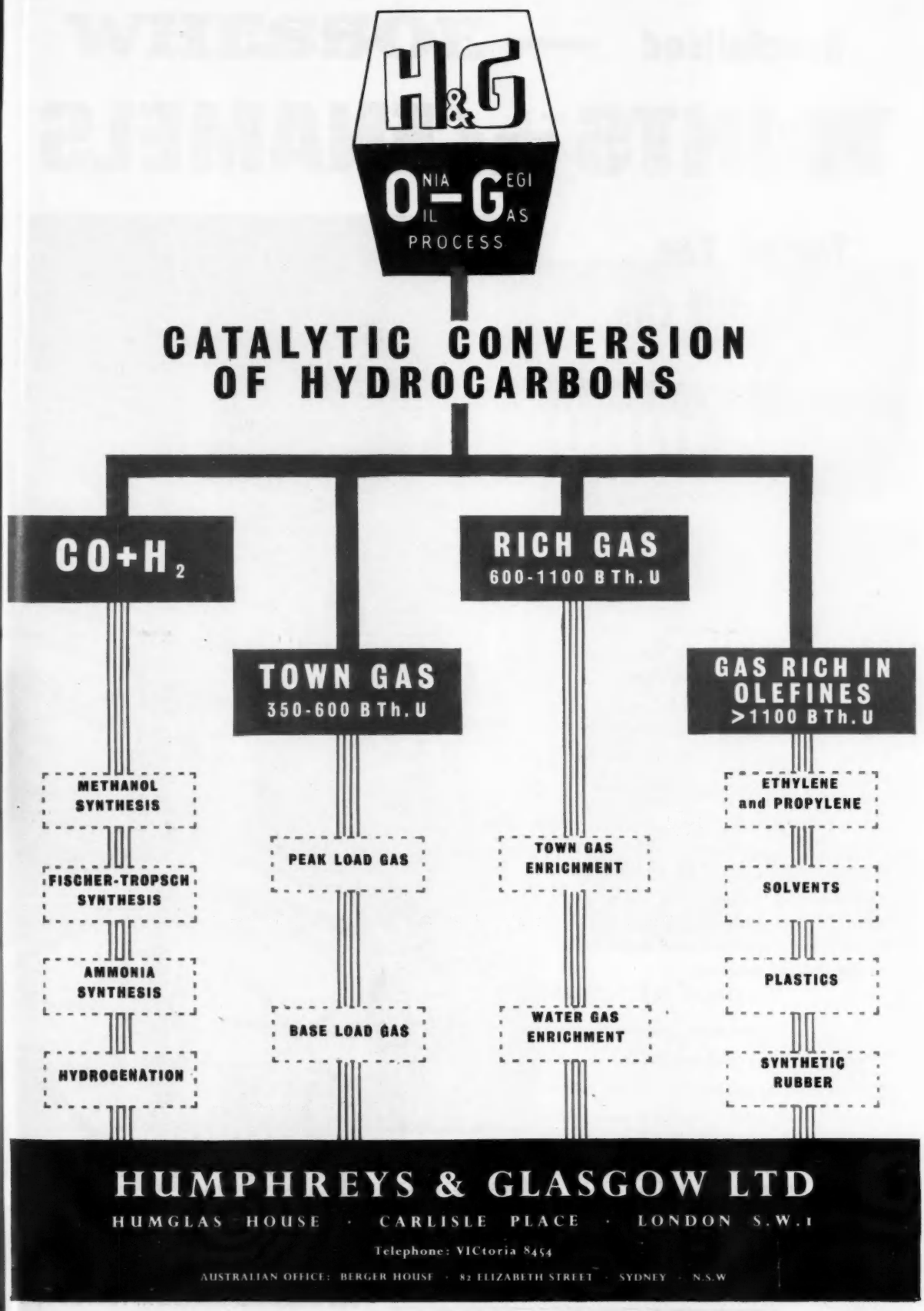
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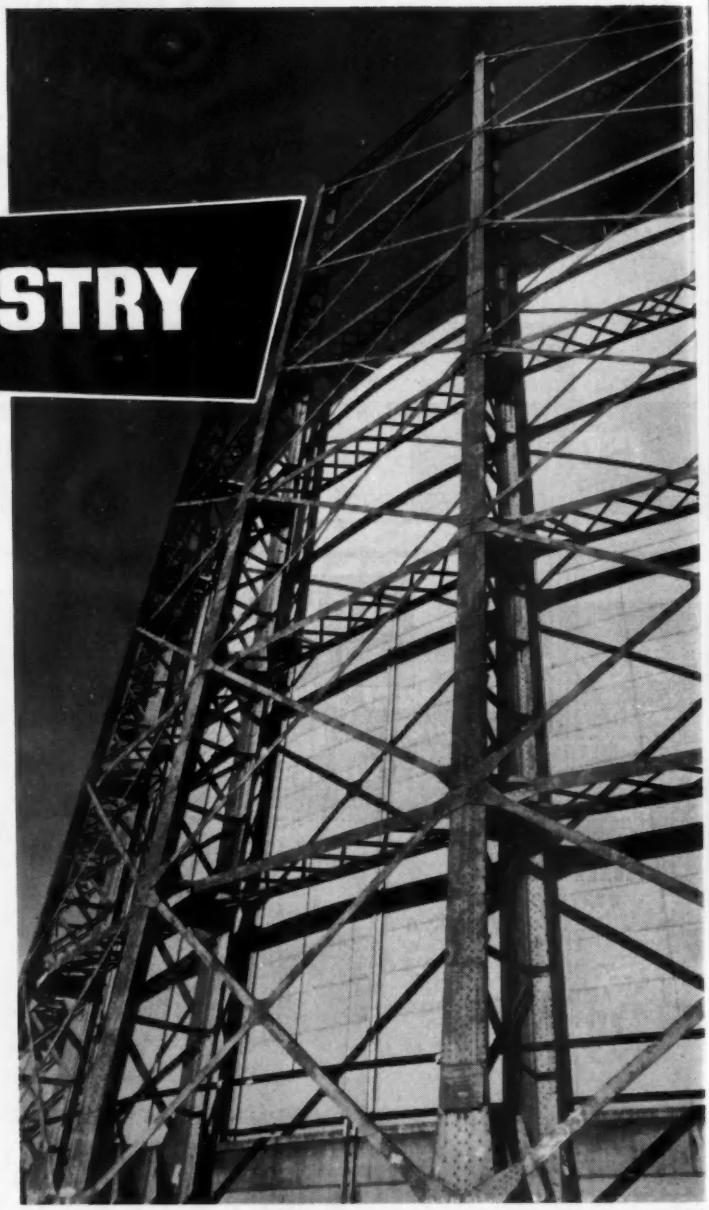

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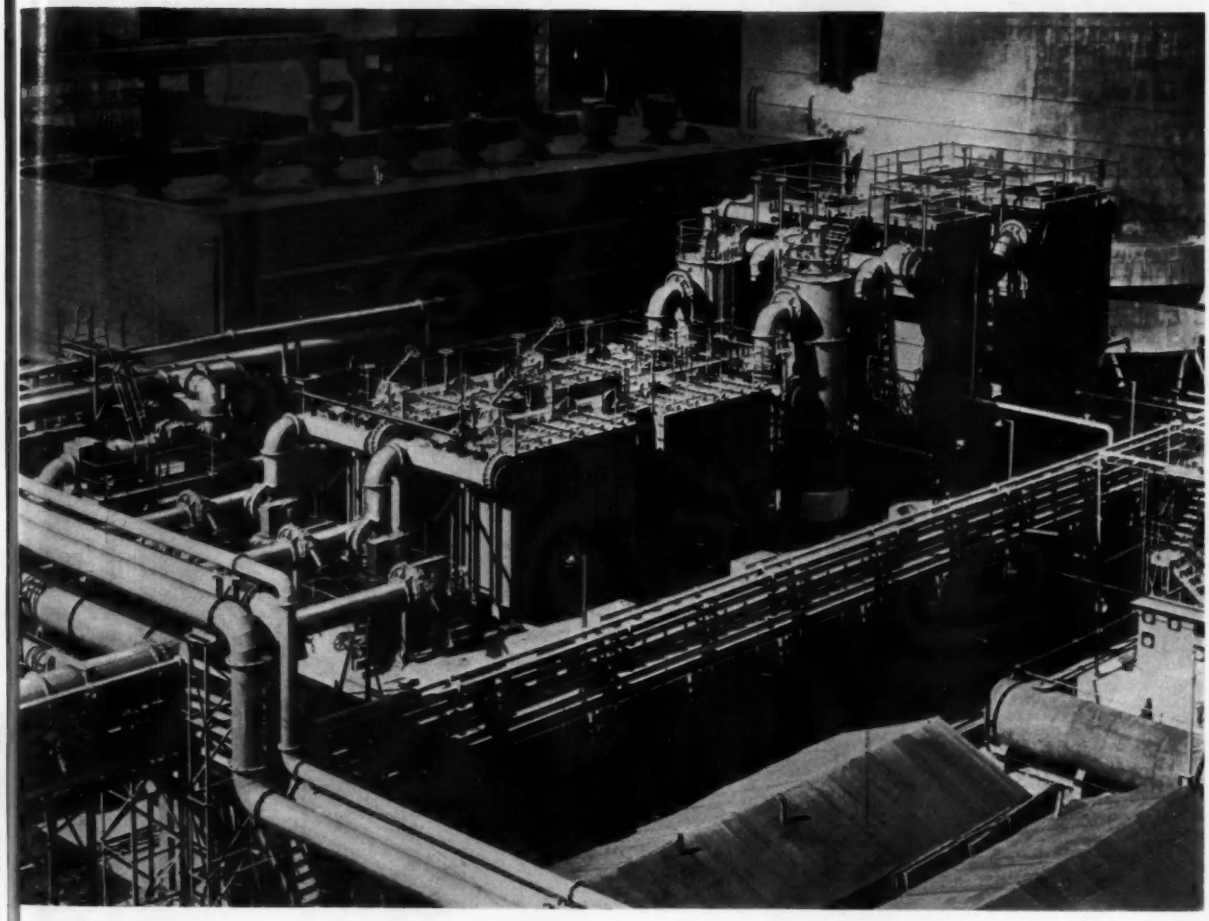

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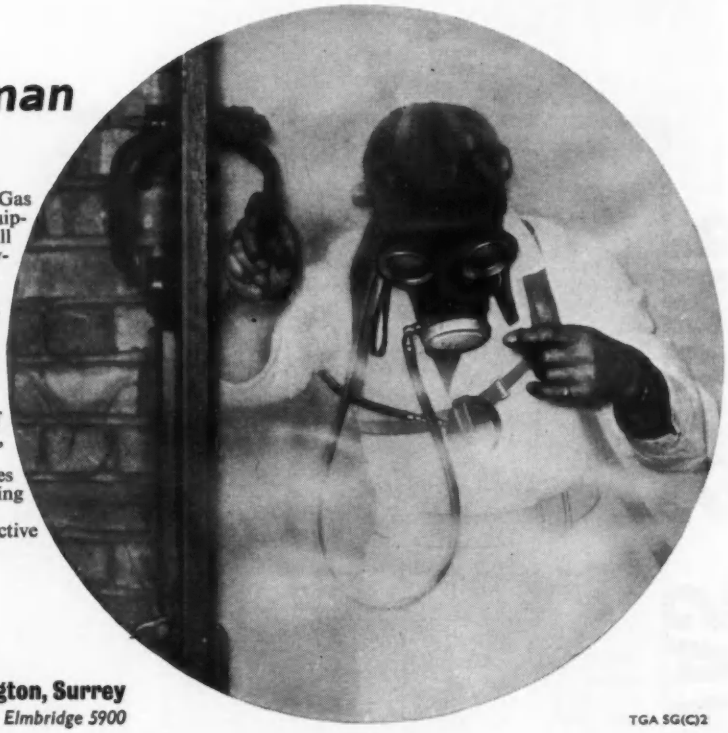

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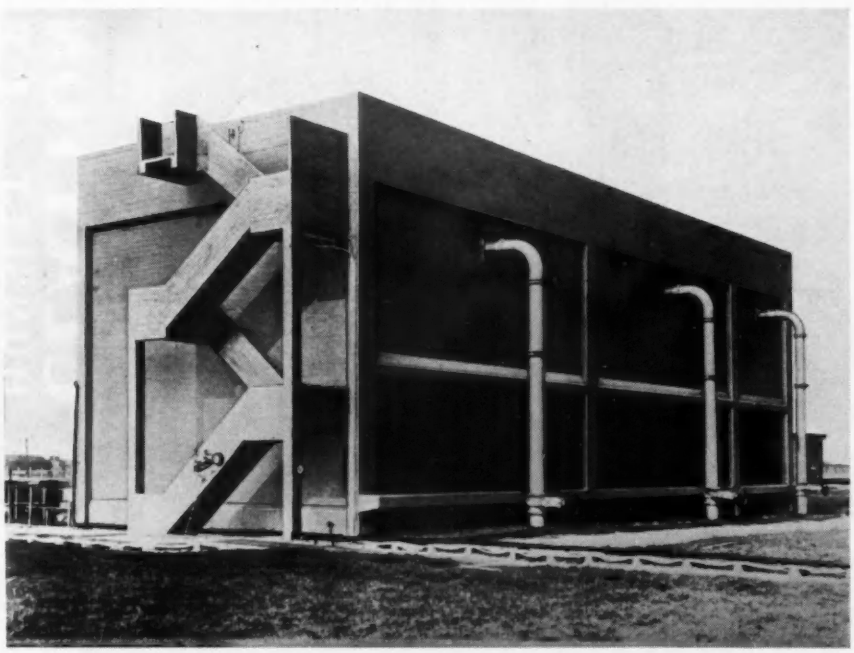

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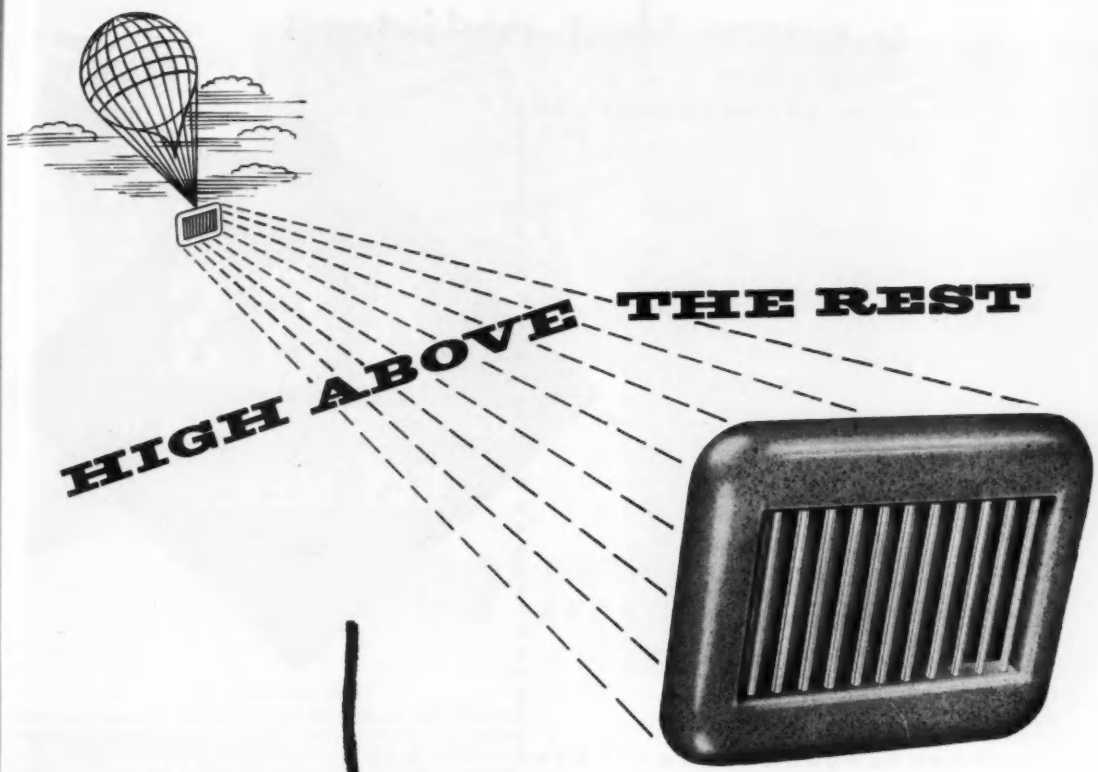

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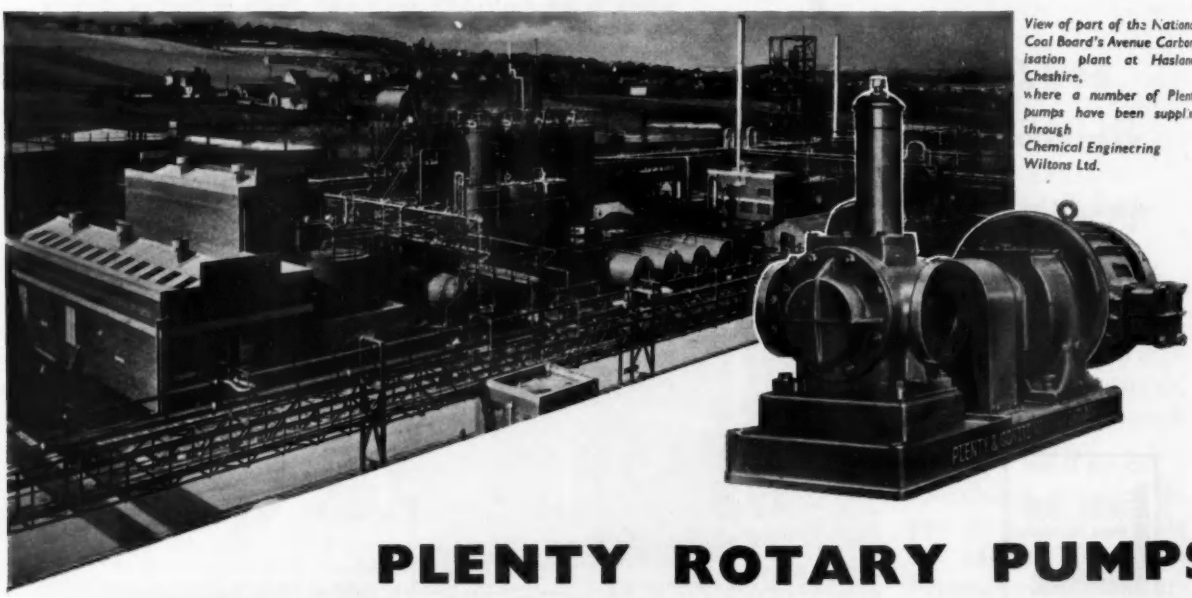

View of part of the National Coal Board's Avenue Carbonisation plant at Haslam, Cheshire, where a number of Plenty pumps have been supplied through Chemical Engineering Wiltons Ltd.

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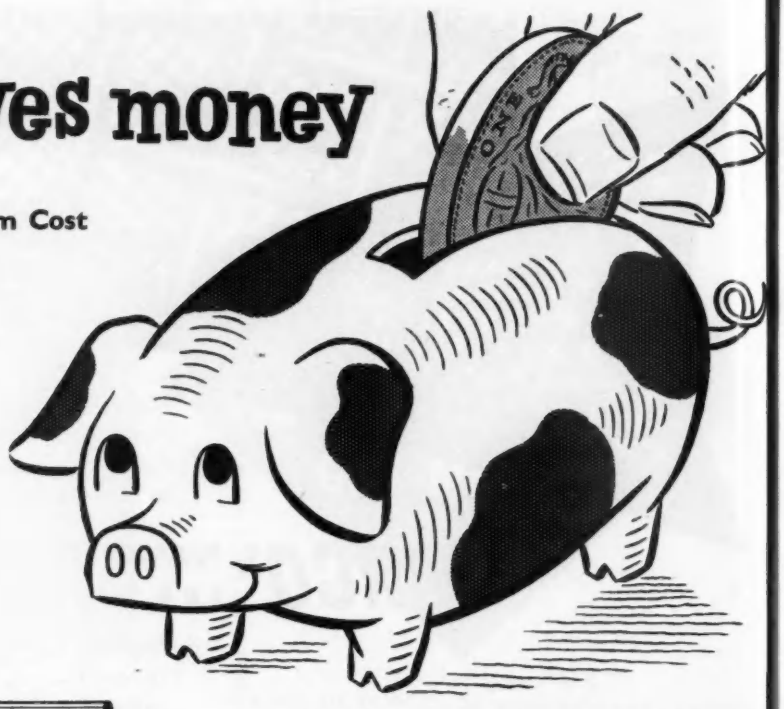

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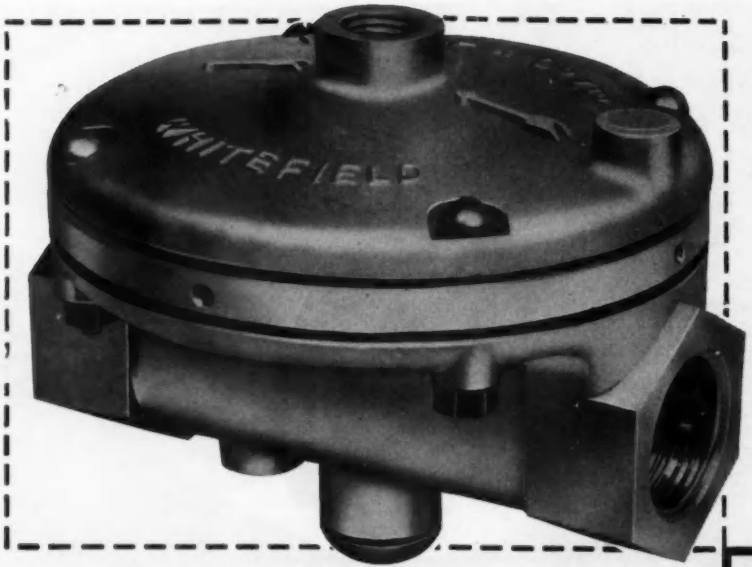

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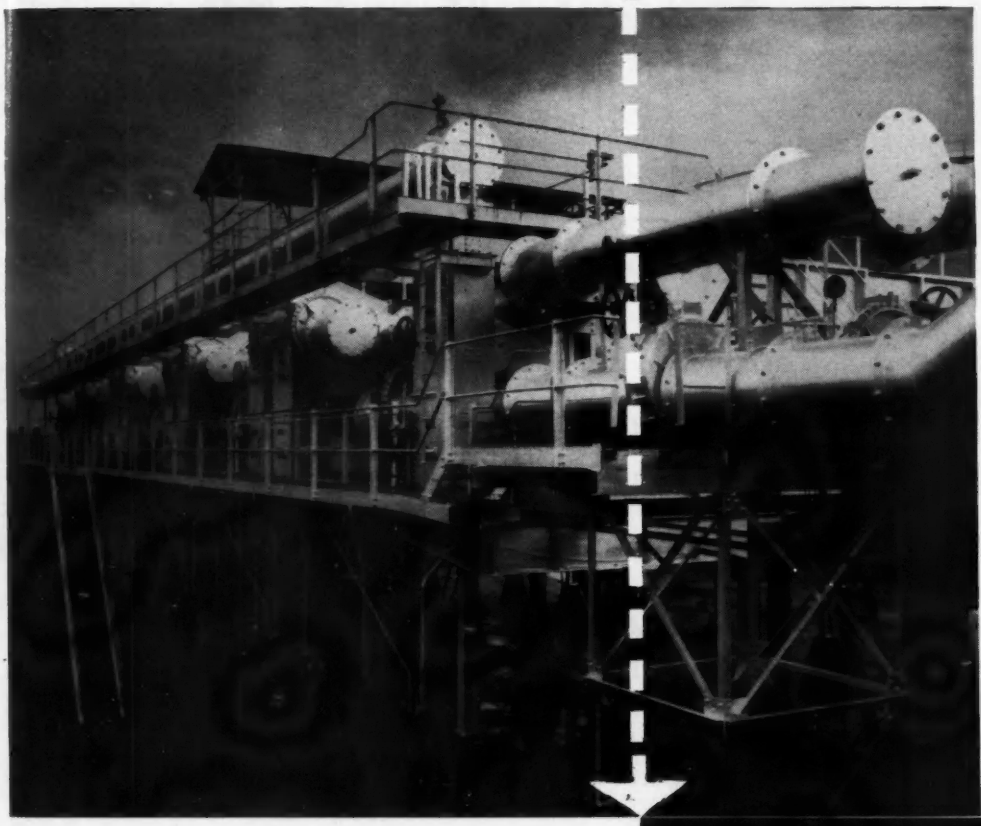

Wigan Deep Purifiers. Photograph by courtesy of the North Western Gas Board and The Oxley Engineering Co. Ltd.

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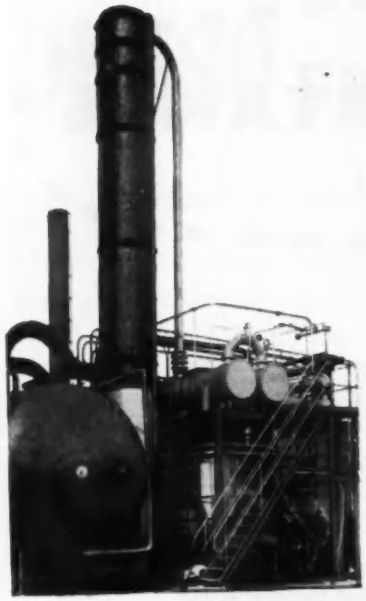

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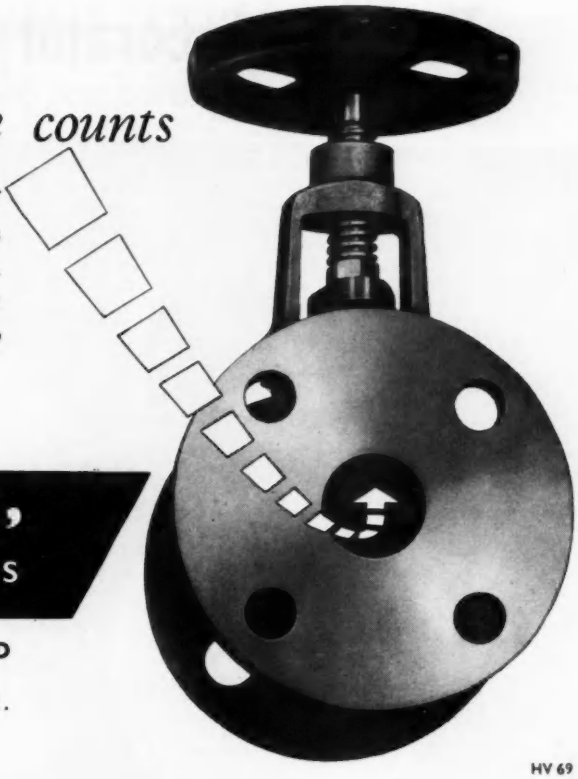

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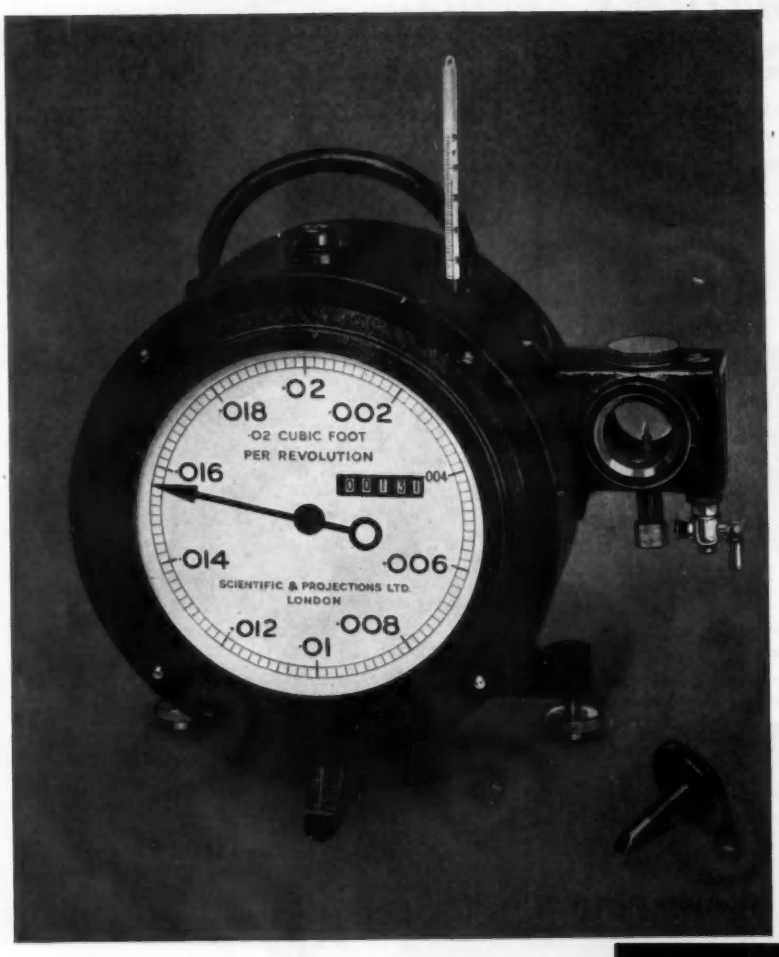

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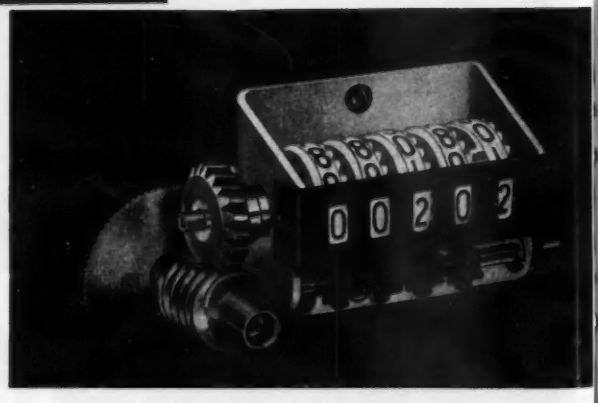

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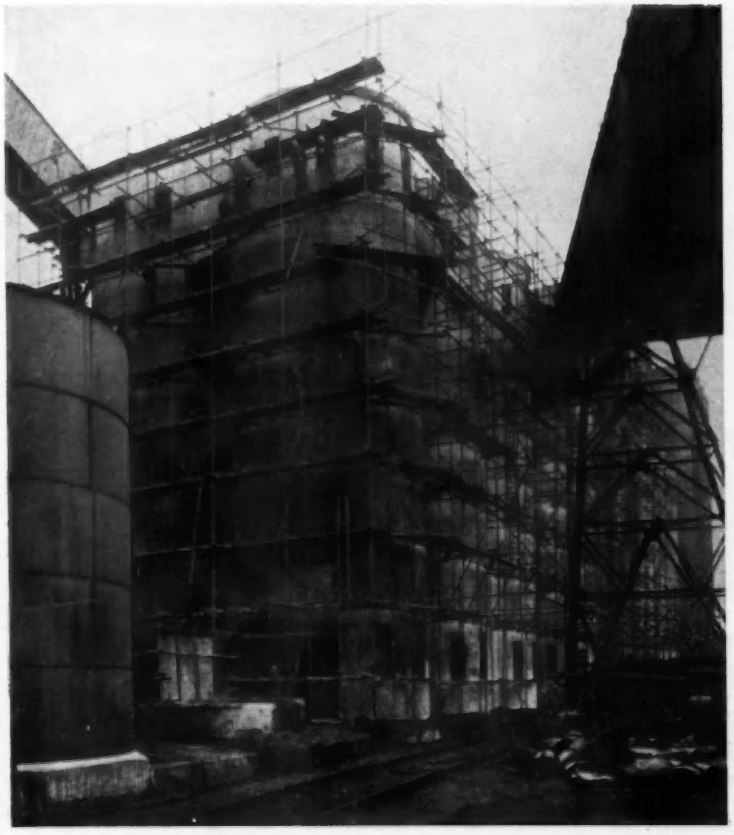

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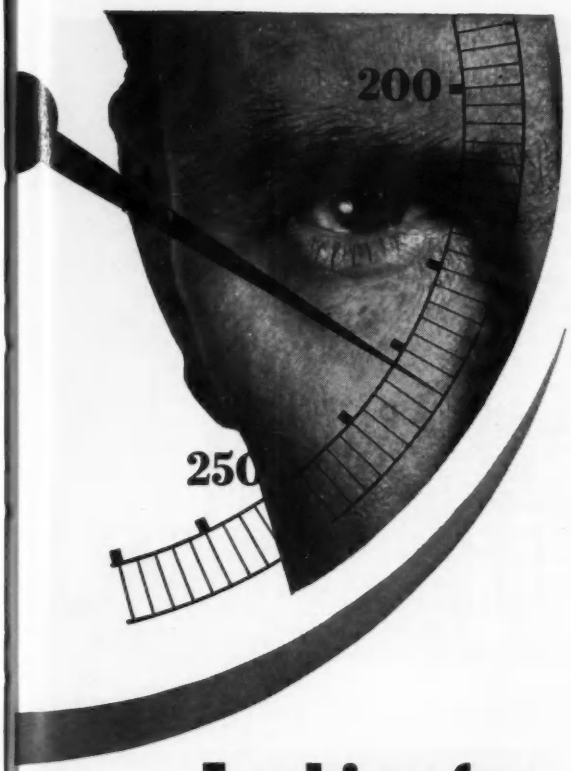

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Gas Journal

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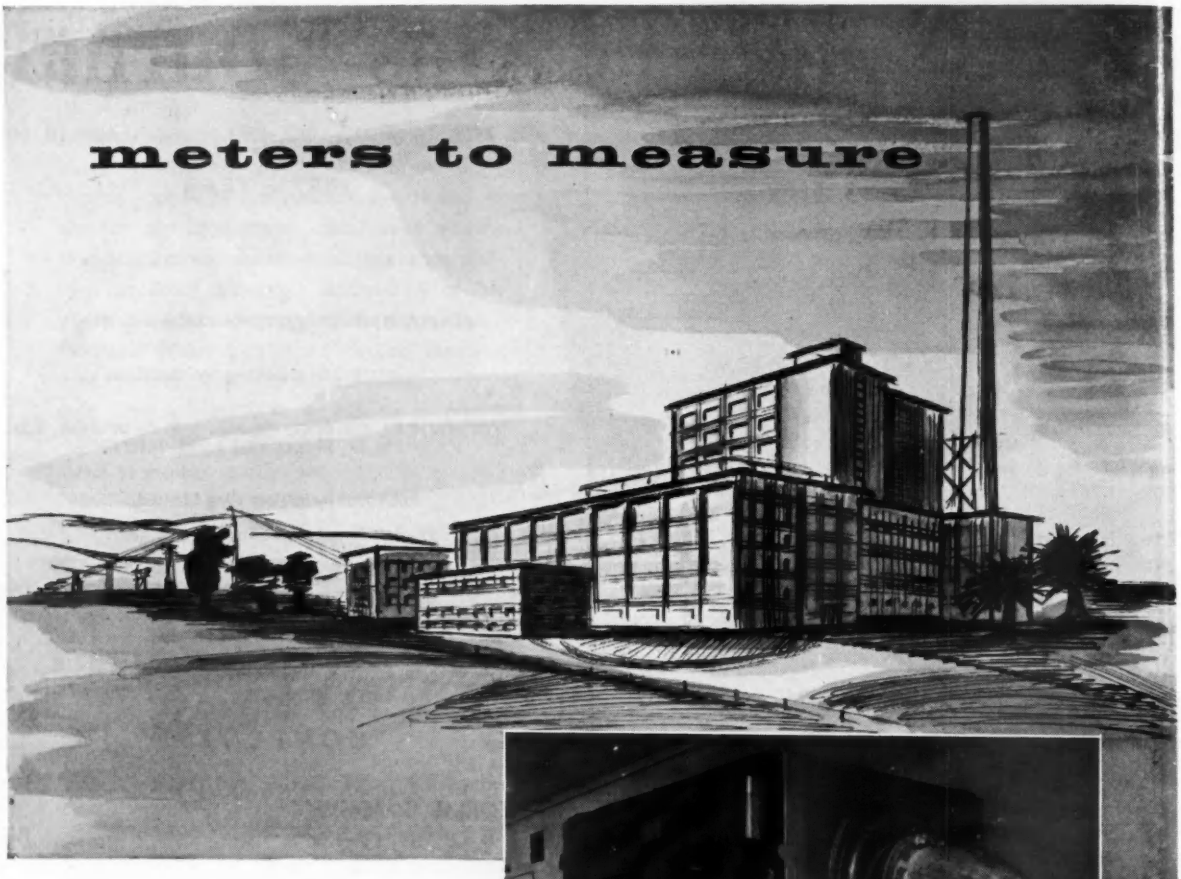

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Gas Journal

VOLUME 290. No. 4891. APRIL 10, 1957. 109th YEAR

New Thinking at Lincoln

LIKE every other form of organised activity, the gas industry is constantly changing its outlook and aims. Sometimes it is healthy competition with some other fuel service which makes the industry change its methods, whether of selling or in the design of its appliances, or some technical advance is made which revolutionises the manufacture of gas or improves the efficiency of gas-burning equipment. But there is generally something much greater working behind the scenes which gives an incentive to human endeavour; apart from an inner driving force which seems to actuate some rather rare types of people, this generally boils down to simple economics.

For us, in some form or other, integration had to come, and, after an evolutionary period of nearly 140 years, the gas industry as a whole became 'big business.' At last the supply and manufacture of gas could be put on a really sound scientific and engineering basis throughout the whole of the British Isles, and not merely in our larger cities. It was recognised that this would take time and would mean a great upheaval among the smaller and more remote undertakings where the engineer and manager had been more of a personage than a technologist, as local circumstances and conditions demanded.

Against this background, our interest in the paper we publish in this issue on the Lincoln undertaking will, we think, be shared by a great many who realise how conditions have changed since the early 1930's. It was then that this undertaking's distribution system was redesigned to meet the development of the city of Lincoln by the coming, and subsequent expansion, of industry there. The paper by Mr. D. W. Ault, Engineer, and Mr. J. W. Wilson, Distribution Engineer, entitled 'The Development of the Lincoln Undertaking,' describes how the distribution system and manufacturing plant have been developed since nationalisation in 1949.

The distribution system is particularly interesting since the feeling persists that little change would have been necessary had those responsible for the modification of the layout 25 years ago tackled the job with the necessary foresight and, more particularly, sound engineering knowledge. Could not more thought have been given to the provision of the high pressure and low pressure distribution system and their relative importance, so that all the gas from the holder, whether to the low pressure system or the inlet of the compressors, would not have had to pass down the same main? Even if the development of gas supplies in the old town on the hill has been more rapid than might have been expected, the industrial consumers can hardly be blamed if they take the major part of the gas before it ever gets to this part of the city. Even just before nationalisation the solution of the whole problem was considered to be the mere installation of another compressor. In other words, the matter was being tackled piecemeal; it was not treated as part of a much larger problem and no thought was given to possible future developments.

The difficulties under which so many undertakings

THE BUDGET

IN a speech which, in the words of Mr. Griffiths, deputy Leader of the Opposition, lacked 'metaphors or resounding perorations,' Mr. Peter Thorneycroft, the Chancellor of the Exchequer, presented his first Budget yesterday. He gave relief to surtax payers, shipping companies and U.K. overseas trading concerns, and on petrol, but for the gas and electric appliance industry there were no concessions. Although the rate of purchase tax on several types of household goods has been cut from 30% to 15%, the goods affected include appliances which are not operated by electricity or gas. Those who hoped that the tax burden on refrigerators, water heaters, and washing machines might be eased, have therefore been disappointed, but we believe the major handicap in the sale of these appliances has been hire purchase restrictions rather than purchase tax. And Mr. Thorneycroft made it quite clear that the credit squeeze is to continue. On the other hand, purchase tax and hire purchase concessions can be made at any time and there are reasons why the Chancellor might prefer to revise the present ruling on these matters on another occasion.

The biggest cause for regret is that nothing has been done to bring space heating appliances into line and so remove the unfair advantage given to oil and solid fuel. And what incentives are there to clean air and clean food?

found themselves after the war, a legacy of such small scale thinking, would have been impossible to overcome without the new resources of clear planning and finance which became available with the new set-up. These difficulties overcome, the large consumer could be encouraged in becoming more gas minded. In the section dealing with reorganisation of the works, the paper shows that the gas making capacity at Lincoln has always been ample, but points out that the installation of ancillary plant seems to have been planned on a somewhat doubtful premise. Not the least remarkable feature was that the unusually long foul main seems to have had a most welcome effect in acting as an atmospheric condenser which prevented tar going forward to the purifiers, although whether this could be attributed to a good planner or a kind providence is a matter for conjecture!

The design of the second purifier stream appears to have been accepted with an unusual lack of knowledge of the pressure effects on the two streams together, and as readers of the paper will perceive, the coal handling arrangements have been saved from a most primitive state of affairs by a stroke of genius on the part of the Deputy Engineer. These days when everyone is thinking ' big,' and the necessary capital is being made available for investment in new ideas and new plant, such methods of ' muddling through,' typically British though they may be, are so expensive as to be prohibitive. Today the whole aim of industry is to make the machine do the work and man the thinking.

The Carbonising of Swelling Coals

A PAPER recently read before the Institute of Fuel by Mr. J. L. Lambert, of the Guest Keen Iron & Steel Co., Ltd., and W. J. Lancucki-Pater and G. W. Lee, of the British Coke Research Association, described a number of experiments with swelling coals with a volatile content as charged varying from 14.0% to 29.5%. Such coals are of little interest to the gas industry for its carbonising plants but are in considerable demand for coking plants in South Wales where the tests were carried out. Their chief interest lies in the fact that it is necessary to blend them to give a coal that not only forms a good coke but can be carbonised in the coke oven without causing damage from undue swelling pressures in the oven during carbonisation.

To arrive at a satisfactory figure of the swelling pressure caused by the carbonisation of any coal or blend of coals it is customary to make use of the movable wall coke oven. This consists of a small scale coke oven with a capacity of 1,000 lb. of coal, one wall of which is fixed in the ordinary way while the other can move as the charge begins to swell during carbonisation. Means are provided for measuring the pressure exerted by the charge. This is the usual way of measuring the suitability or otherwise of a new blend of coal before charging it into an oven and is well known from the experiments of Koppers and Jenkner 25 years ago, who stated that the maximum permissible pressure was 1.2 lb. per sq. in.

Until the publication of this paper no experiments had been actually carried out in a full scale coke oven plant, since such plants are extremely expensive and the damage which might be caused by swelling coals might be costly and would interfere with the plant's normal life span of 15 years or so. However, the authors of this paper were fortunate enough to be allowed to make their experiments in a coke oven battery belonging to the Guest, Keen Iron & Steel Co., Ltd., which was due for rebuilding. The experiments are of considerable value to the coke oven engineer since he can see immediately the actual effect of the damage on a coke oven wall, and at the same time he can be certain whether coal of greater swelling pressure than he first thought was advisable, can in fact be used. The figure of 1.2 lb. per sq. in., postulated as the maximum permissible by Koppers and Jenkner, was based on experiments on a single cold wall, whereas in practice the strength of a hot wall is considerably influenced by the buttressing effect of neighbouring walls and charges. With this in mind the British Coke Research Association suggest that to avoid damage which might shorten the life of a coke oven battery, a coal, crushed to 80% through an $\frac{1}{8}$ in. mesh and with a moisture content of 7% or above, should show a maximum pressure of less than 2 lb. per sq. in.

The results the authors obtained from the charging of different blends into the full scale oven show that the coals with greater swelling pressure than was first considered safe may be used without actually cracking the oven wall, though perhaps it would not be particularly wise to make use of such coals in practice because of the undue difficulty there would be in discharging the oven, and because of the very severe strain on the wall which is being continually subjected to the higher pressure. In fact the maximum swelling pressure of 2 lb. per sq. in. as advised by B.C.R.A. would appear to be justified. Each blend of coal was first tested in the movable wall oven to measure its swelling pressure before the test was carried out in the full scale plant so that its behaviour under ordinary commercial conditions could be predicted.

Coals with a swelling pressure of less than 1 lb. per sq. in. caused no measurable movement of the wall; coals with swelling pressure between 1 lb. and 4 lb. per sq. in. produced an elastic movement in the wall, and the first cracks appeared after 4 lb. per sq. in. Further tests under pressures of 9 lb. per sq. in. and 11 lb. per sq. in. showed further increases in the deflection of the wall. The authors conclude that elastic deflections of the wall of the commercial coke oven can take place up to .5 in. without showing any visible cracks, but beyond this further deflection did not occur so readily and was accompanied by substantial cracks. At the greatest pressure, 11 lb. per sq. in., the wall failed to return to its original position after test. The extra pressure sustained over the Koppers-Jenkner value of 1.2 lb. per sq. in. is considered as being caused by the difference in strength between a fixed wall of well fired material which has been kept at an elevated temperature perhaps for years and the cold, partly fired material composing the wall in the Koppers-Jenkner test plant.

To carry out these measurements a scissors gauge was put above the charge through a charging hole and by means of a film camera fitted with a water cooled optical system, a complete record of the effect of the swelling charge could be made.

An Important Survey

LAST week we devoted our first leader to the paper 'Selling a Heat Service,' by Mr. Alan Middleton, Commercial Officer of the Northern Gas Board. Mr. Middleton was concerned about the domestic gas load and produced a substantial amount of evidence to support his contention that a change of heart and perhaps of technique is necessary if in future we are to hold our own. His arguments are strengthened by a most interesting report produced by Odhams Press Research Section. This contains information obtained by a sample survey carried out in June and July, 1956, among almost 4,000 housewives in Great Britain. The sample was stratified by area and town size and 138 different sample points were randomly selected. The object of the survey was to enquire into the ownership of certain domestic appliances, furniture and furnishings, and in addition to find out the brands of appliance, or furniture, persons had obtained in the past five years. This particular report, No. 4, deals with gas appliances and miscellaneous domestic appliances; further reports will deal with electrical appliances and furniture and fittings.

In the space at our disposal it is not possible to assess the results. Our purpose is to bring the report to the notice of our readers and advise those interested to obtain a copy for themselves. (Although the series of reports is issued by *Woman* 'as a service to advertisers and their agencies,' it should be possible to obtain a copy from the publishers.) However, we might mention that one rather melancholy footnote reads: 'The number of housewives who had obtained a gas refrigerator in the past five years was too small to enable a breakdown to be given.' The real value of this survey will not be apparent until the next section, dealing with electrical appliances, is published.

Accent on Youth

ONE of the facts revealed in the Odhams survey is the importance of the 16-24 age group among housewives and it is pertinent to enquire just what is done to enlist the support of this section of the community who will probably constitute the success or otherwise of our domestic load for many years to come. Figures show a definite trend away from gas for cooking among these young housewives, although their allegiance to electricity is not always continued when they have gained more experience of their own and other people's cooking facilities. Somehow or other the young brides must be convinced that gas is the fuel for them, that it is as modern as tomorrow. Publicity along the lines of the Bride of the Year competition is helpful, and so are the various lectures and demonstrations to schoolgirls given by area gas boards. But it is unlikely that the Women's Gas Federation makes any great appeal to the under 25 age group and there would seem to be a need for something with a more, shall we say, glamorous approach. One cannot help looking to America where this problem is tackled in a very energetic and effective manner. An example is the 'Teenage Cooking Club,' a television cooking show sponsored by Brooklyn Union and the Caloric Appliance Corporation, which has netted wide praise in the Press. This constitutes the second part of a one-hour programme, the first part being intended for the gourmets and serious cooking hobbyists. In this country it is not possible to use the medium of television in this way, but we have quoted this example to show, (a) that the American utilities are alive to the need for real endeavour in the field, and (b) that they are not afraid to spend money on it. There is every indication that it will be a sound investment.

Personal Notes

MR. A. IFAN JONES, M.B.E., retired on April 1 after 61 years in the gas industry. Mr. Jones started work as a fitters' apprentice in 1896, was appointed Manager of Pwllheli in 1914, and became General Manager of the Holyhead and North Wales Gas and Water Corporation in 1917. Appointed Secretary and General Manager in 1924, he was elected to a seat on the Board in 1935 and made Managing Director in 1940. In 1949, Mr. Jones was appointed Chairman of the Anglesey Group of the Wales Gas Board, and later also made Chairman of the Caernarvonshire Group. Mr. Jones has been made a presentation by Mr. E. M. Edwards, Member of the Wales Gas Board, on behalf of the Board, members of the Anglesey Group Committee, and staff of the Anglesey undertaking.

MR. H. C. HAWKINS of B. X. Plastics Ltd., has been appointed President of the Combustion Engineering Association for 1957-58. Vice-presidents appointed for the year are: SIR JOHN CHARRINGTON, Charrington, Gardner, Locket & Co. Ltd.; MR. B. SAMUELS; SIR PERCY SANDERS, C.B.E., Association of Shell Boilermakers; MR. E. W. THOMPSON, John Thompson Ltd. Other appointments are MR. L. N. HORNE, as Chairman of the Council, and MR. E. W. BARNES, Honorary Treasurer.

MR. A. J. M. HENSHAW, Director, has been appointed General Sales Manager of W. C. Holmes & Co., Ltd. Prior to this appointment Mr. Henshaw was Contracts Manager. As a result of this new appointment MR. W. SYKES will now take over responsibility for the contracts, erection and buying departments in addition to his present duties as works director and director in charge of the gas cleaning division. Working under Mr. Sykes as managers of the gas cleaning division and contracts department respectively are DR. W. T. COSBY and MR. E. TAYLOR.

MR. GEORGE WALMSLEY, M.B.E., Engineer, Managing Director and Secretary of the Londonderry Gaslight Company, has retired. In recognition of his services over a period of 45 years Mr. Walmsley is being elected to the Board of Directors. Mr. Walmsley, a native of Ilkley, Yorkshire, joined the Company in 1912, and was appointed manager in 1924. He was largely responsible for the re-organisation of the Company, and introduced the vertical retort method of gas making. Mr. Walmsley, who was President of the Irish Gas Association in 1931 and 1952 is being succeeded by his Assistant Manager, MR. R. MCDOUGALL, and MR. R. A. RANKIN is being promoted to the position of Secretary.

MR. LEONARD HALSEY, Sales Manager, the National Benzole Co., Ltd., has retired. Mr. Halsey, who is 65, joined the National Benzole Co., Ltd., in 1923, as a Sales Representative in Exeter. In January the following year he was appointed Divisional Manager, Bristol, and on the regrouping of the Company's Divisions in the Midlands and South Midlands, he became Divisional Manager, Midland, in 1931, and Divisional Manager, South Midland, in 1935. At the outbreak of war he joined the Petroleum Board as Assistant Regional Manager, North Midland Region. When the Petroleum Board was disbanded, Mr. Halsey was appointed Group Sales Manager at Head Office. Two years later, in June, 1949, he became Sales Manager.

MAJOR T. W. ADAMS, who has relinquished the office of Managing Director of The Monckton Coke & Chemical Co., Ltd., of Royston, near Barnsley, after 45 years' association with the company, still retains a seat on the board. Mr. J. Gallagher has been appointed General Manager.

MR. E. N. LOWE has been appointed Senior Export Sales Executive, British Tyre & Rubber Co., Ltd. Mr. Lowe was previously Overseas Manager of Semtex, Ltd.

Goods Vehicles May Have To Fit Wheel-space Guards

ANOTHER MOVE IN ACCIDENT PREVENTION WAR

GAS undertakings are likely to be affected by regulations now being planned by Mr. Harold Watkinson, the Minister of Transport, to require the compulsory guarding of the space between the front and rear wheels of goods vehicles, including trailers, as part of the national campaign to reduce the high level of road accidents.

In a letter to the local authority associations seeking their views, Mr. Watkinson says suggestions have been made that if this measure were adopted a number of serious accidents, particularly those involving children and cyclists, would be avoided.

The Minister says he considers that these suggestions, in the light of modern traffic conditions, have considerable force.

Under the Public Service Vehicles (Conditions of Fitness) Regulations public service vehicles are already required to have the space between the wheels on either side effectively guarded.

Mr. Watkinson has suggested that a similar requirement applicable to goods vehicles and trailers might be on these lines:

If any two wheels on either side of a vehicle have a clear space of more than 2 ft. between their nearest points, that space shall be effectively guarded to within 9 in. of the front wheel and 6 in. of the rear wheel and to within 15 in. of the ground when the vehicle is carrying no load and is standing on level ground.

It is proposed that any such requirement should apply to all goods vehicles, including three-wheeled vehicles and trailers, which are first registered after some future date.

Consideration is also to be given to making it obligatory to guard the space between the rear wheels of a goods vehicle drawing a separate trailer and the front wheels of the trailer, if a practicable solution can be found to this problem.

SILVER MEDAL AWARDS ANNOUNCED

THE Council of the Society of British Gas Industries have again this year awarded Silver Medals to the junior gas associations for the best paper adjudged to have been presented during the year. Twenty-five papers were submitted by nine associations. The winners are as follows:—

London Juniors: 'Pressure gasification—one way to a cheaper therm,' by C. Ryder.

Manchester Juniors: 'Electro-chemical corrosion of metals,' by R. J. Bramhall.

Midland Juniors: 'Mechanisation—Some experiences in its application to pipelaying and maintenance,' by B. J. Hawkings.

Northern Juniors: 'An unusual problem of gum formation,' by F. W. Sawyer.

Scottish (Western) Juniors: 'Automation in the gas industry,' by G. A. Wood.

Wales and Mon. Juniors: 'Unaccounted-for gas,' by C. J. Pope.

Western Juniors: 'The chemical control of a modern base load works,' by D. R. Jones.

Yorkshire Juniors: 'Some aspects of pressure and flow control,' by L. Ward.

High Costs Close Cookstown Works

TWO-HUNDRED Cookstown (Co. Tyrone) housewives have cooked their Sunday dinner for the last time by gas. For on March 31 the century-old local gasworks ceased production owing to increased cost of manufacture.

Originally about 570 houses in the town used gas, but since the works announced their impending closure about eight months ago, many have switched to bottled gas and electricity.

The Company offered to sell the works to the Cookstown Urban Council, but the Council refused to take them over.

Deputy-Chairman of the South Eastern Board, Mr. R. H. Sandford Smith, listens to Mr. J. Adams, of Tunbridge Wells, explain his suggestion for the repair of scrubber standpipes in horizontal retorts.

In Brief

MORE IDEAS WIN BOARD'S CASH PRIZES

THE largest number of awards ever in the South Eastern Gas Board's suggestion scheme were made recently by the Deputy-Chairman, Mr. R. H. Sandford Smith.

The scheme is two years old. This presentation of cash prizes was for the December, 1956 quarter, during which 30 suggestions were received. Twelve were successful.

A 120 ft. chimney stack at the Basingstoke (Hants) gasworks has been demolished. It had been a landmark in the town for many years, and was felled to make way for a new gasholder. The job of demolishing the whole works will be completed in about two-and-a-half months.

The Australian Wine Festival has been held at the Continental Hotel, Plymouth, and Miss Elinor Gordon has been demonstrating four Australian dishes at Radiant House, Plymouth, the South Western Gas Board's premises in Plymouth.

Lanarkshire County Council have decided that in all future developments where cookers and wash boilers are installed, the tenants will hire the appliances. In this way the Council will cut housing costs.

Although it is agreed that street lighting by electricity would be 'a definite improvement' on the present gas lighting, it is unlikely that Broadway, Worcs., will make the change-over at present owing to the cost.

The South Eastern Gas Consultative Council has decided not to support the North Western Council in pressing the Board of Trade to grant more favourable hire purchase terms for gas cookers.

Company News

Parkinson Dividend Back to Normal

PARKINSON & COWAN, LTD., is paying 9% for 1956, restoring the rate in force prior to the cut to 5% for 1955.

Group trading profits, which fell from £383,167 to £218,877 in the previous year, amount to £597,497. After depreciation £200,448 (£160,552) and tax, excluding distribution profits tax, £172,257 (£2,469), there is a net balance of £171,536, compared with the 1955 deficit of £35,456.

Reserves receive £76,000, against a £25,000 reduction, and the carry-forward is increased by £12,613 (reduction £57,074). Group reserves and surplus stand at £619,814.

Cork Gas Consumers' Pay 7% for Year

Cork Gas Consumers' Company propose to pay a final dividend of 3½% making 7% for the year, less tax. This will absorb £3,281, leaving a credit balance of £7,908 carried forward.

Yorkshire Juniors Hear Expert Talk on Natural Gas Search

POSSIBILITIES STILL EXIST IN COUSLAND ANTICLINE

AT a meeting of the Yorkshire Junior Gas Association held in the gas showrooms, in the Kirkgate Market, Leeds, Mr. I. Gillesby of Shell Mex & BP Ltd., showed three films illustrating his subject—the search for natural gas—and also gave a short address on the various experiments carried out in different parts of the country in drilling in search of natural gas.

The BP Exploration Company, he said, had tested the possibility of Permian gas and oil by drilling in 1937 a 4,040 ft. well at Eskdale in North Yorkshire. This hole gave a gas production from the upper limestone of nearly pure methane at 2.5 mill. cu.ft. per day. In drilling this test the possibilities of potash salts in the Permian were not overlooked and extensive coring was carried out to get bulk samples of any valuable material. This proved to have been justified and substantial potash salts were discovered.

I.C.I. and Fisons

Mr. Gillesby said that in recent years both the I.C.I. and Fisons had drilled a number of boreholes to determine the extent of the potash deposits and the feasability of exploiting these by mining. In conjunction with the Exploration Company, I.C.I. have also continued the search for a commercial accumulation of methane gas in the Eskdale area. In 1954 an additional supply of Permian gas was found in the lower limestone.

The first well in Scotland was drilled in 1937 at Cousland near Dalkeith, South-East of Edinburgh, where it was hoped to find oil in lower carboniferous rocks, but instead methane gas was struck in the Cousland dome. During 1954 another well was drilled in the Cousland dome on behalf of the Gas Council but unfortunately this well failed to prove commercial gas production. This result reduced the scope for finding additional gas reserves in the Cousland anticline although possibilities still exist.

Further Exploration

During the same year a re-examination of gas prospects in Southern England began with investigation of the Ashdown anticline. Four shallow holes were drilled for closer definition of the structure and a deep well put down. This found a small gas show at 2,598 ft. and some oil at 3,721 ft., both in Jurassic rocks. It was completed at 4,538 ft. and further exploration is in progress.

MANAGERS AND T.U. CHIEFS ARE BECOMING CHAIRBOUND

—*N.E.G.B. Member*

'MANAGERS and trade union officials are becoming far too much tied to their chairs,' said Mr. A. McDonald, member of the North Eastern Gas Board, at the annual dinner of employees and friends of the No. 7 Group, N.E.G.B. branch, N.A.L.G.O., at Hull. 'If only they could leave their desks for one day a week or a month to talk with their colleagues it would do far more good to remove frustration and help productivity than all the resolutions passed at committee meetings.'

On the question of industrial relations, Mr. McDonald, who was proposing the toast to the branch, said he believed that many managers, trade union officials and shop stewards concerned themselves with welfare. They were not just concerned about wages or production requirements; they believed in good relations.

Throughout the history of trade unions and in the ranks of employers there had been many men and women who had been striving to help their fellow employees simply because of their belief in human nature. 'If you were to examine the records of almost any of our trade unions or personnel departments in any works, you would see just how much they are called upon to handle problems of human nature.'

Mr. A. L. Higham, Group General Manager, replying, said: 'Courtesy to our consumers and goodwill among our workers and employers are the keynote of this Group.'

Chief guests included Mrs. A. McDonald, Mrs. A. L. Higham, Mr. A. Cole, Group Deputy General Manager, and Mrs. Cole, Mr. and Mrs. L. Walker. Branch, officials present included Mr. H. Brown, Chairman, Mr. H. Nicholl, immediate Past-President and Mrs. Nicholl, Mr. K. Wheeler, Secretary, and Mrs. Wheeler, Mr. T. J. White, Treasurer, and Mrs. White.

RECOMMENDED HOME HEATING EQUIPMENT

THE list of recommended domestic solid fuel appliances published by the Coal Utilisation Council and the Solid Smokeless Fuels Federation, will in future be issued annually instead of twice-yearly. The current list, No. 14, was issued at the end of March.

Two supplements to list No. 14 will be issued, one in June and a main supplement, which will be cumulative, in September. Local authorities will receive the September supplement from the Ministry of Housing and Local Government, and can obtain copies of the June supplement as well by direct application to either the Coal Utilisation Council, or the Solid Smokeless Fuels Federation.

Isle of Man Company Centenary

Ramsey Gas Light Co., Ltd., Isle of Man, will celebrate its centenary this year.

At the annual meeting of the Company, the Chairman, Mr. J. C. Brew, stated that houses in Ramsey were first lit by gas on November 19, 1857.

He also said that during the 1956 season gas sales showed a welcome increase. Coke sales showed a slight increase. Sales of Calor gas and appliances were satisfactory.

The usual dividend of 40s. a share was declared.

Diary

April 11.—EASTERN JUNIORS: The Institution of Gas Engineers, 17, Grosvenor Crescent. 2.15 p.m.

April 11.—MIDLAND JUNIORS: Staff Mess Room, West Midlands Gas Board, Council House, Birmingham. President's Day.

April 12.—MIDLAND SECTION, I.G.E.: Queen's Hotel, Birmingham. A.G.M. Luncheon: 12.15 p.m. for 12.45 p.m.

April 12. — NORTHERN JUNIORS: Stockton-on-Tees. 'High B.Th.U. Oil Gas Production,' Dr. G. Milner. 2 p.m.

April 13.—WESTERN JUNIORS: Bath. A.G.M. and Presidential Address. Postponed.

April 15. — COMBUSTION ENGINEERING ASSOCIATION: Houldsworth School of Applied Science, The University, Leeds 2. 11 a.m.

April 15.—EASTERN G.C.C.: Watson House Centre, Townmead Road, Fulham, S.W.6. 11.30 a.m.

April 16.—INCORPORATED PLANT ENGINEERS, South Wales Branch: South Wales Engineers' Institute, Park Place, Cardiff. 'Gas in Industry.' 7.15 p.m.

April 16-17.—BRITISH COAL UTILISATION RESEARCH ASSOCIATION: Conference. Majestic Hotel, Harrogate.

April 17. — YORKSHIRE JUNIORS: Huddersfield. President's Day. Visit to Brook Motors.

April 24.—INSTITUTE OF FUEL: Institution of Civil Engineers, Great George Street, London, S.W.1. Presidential Adress. 5.30 p.m.

Progress towards automation adds interest to this year's Physical Society Exhibition

TO the scientifically minded the Physical Society Exhibition of scientific instruments and apparatus is probably the most interesting held throughout the year. And to the gas industry—moving at an ever increasing pace, towards automation—it assumes heightened importance.

Among exhibits of particular interest to the gas industry at this year's show, held in London at the end of last month at the Royal Horticultural Hall, Westminster, was the Cambridge-Thomas recording gas calorimeter, seen on the stand of the Cambridge Instrument Co., Ltd.

This instrument, of a type already used widely by the gas industry in America, is of the flow type in which the heat transfer medium is air. It gives results directly in B.Th.U. per cu.ft. at any standard condition of temperature, pressure and humidity, and performance is unaffected by variations of these characteristics. The calorimeter is sensitive to changes of less than 0.25 B.Th.U. per cu.ft. and the guaranteed accuracy is within ± 0.5% of the range value. The full coverage ranges from 70 B.Th.U. per cu.ft. to 2,400 B.Th.U. per cu.ft.

Other exhibits seen on the Cambridge Instrument Company's stand included a Lindemann electrometer transducer; a new coding system for sequential measurement capable of being applied to 99 or more individual points for the recording of multiple temperatures; a new de Nouy Type model surface and interfacial tension apparatus; printed electrical circuits, of particular value for high class instrumentation; a new rotary microtome; and a versatile multi-ratio gear box.

Among other highly interesting stands was that of Baird & Tatlock (London) Ltd., where a valve switching mechanism for gas sampling was displayed. Designed originally to meet National Coal Board needs, it is intended for application where a gas is required to pass through a number of absorption tubes for one hour each during a 24-hour cycle.

Uranium Analyser

Well in step with nuclear development this company also displayed an 'Analmatic' uranium analyser for use in uranium refining, a liquid flow monitor, auto-titrator and titration absorptiometer, and a continuous flow absorptiometer. Of particular interest was a rapid-combustion micro furnace for the determination of carbon and hydrogen, and sulphur and halogens. The procedure is extremely simple in operation and the technique can be acquired in a few hours, the Company claim.

The Baird & Tatlock stand also had an example of the Fuel Research Station type of 'Bone & Wheeler' constant volume type gas analysis apparatus incorporating latest modifications and additions.

There was also a first class display by Elliott Brothers (London), Ltd., representing the products of their computing, industrial weighing, microwave, research, servo components, guided weapons, and radio and radar divisions.

Two examples of this company's G-Pac analogue computer were on show solving various linear and non-linear problems, including the study of power levels in a nuclear reactor, simulation of a servo system with backlash present and solution of a partial differential equation.

Magnetic film mechanism, designed for use as a file store or as part of the output mechanism in a digital computer, was also seen here, and a punched card reader capable of reading standard 80-column I.B.M. or Hollerith cards at speeds up to 10 per second.

In the industrial weighing section was exhibited a new series of resistance strain-gauge load cells. These cells comprise high-tensile steel members carrying bonded resistance wire strain-gauges, and are built in hermetically-sealed shells tested to 60 lb. per sq. in. water pressure. The gauges are connected in a bridge circuit excited from a low voltage source, and given an out-of-balance signal varying linearly with applied load. Output may be displayed directly by a servo-operated indicator, or converted by means of an analogue-to-digital unit into a signal suitable for operating a digital display indicator.

Ionisation Measurement

The micro-wave division exhibited a variety of equipment, including a demonstration strip transmission line receiver for 3.2 cm. waves, an 8.5 mm. wavelength telephone link, and an experimental precision test bench for microwave measurements at 4 mm. wavelengths; while the research division had on show a number of instruments designed to measure and indicate ionisation.

The servo components division exhibited A.C. pick-offs; servomotors, which the company are developing, in co-operation with the Royal Aircraft Establishment; torquemotors, developed from a design by the Royal Aircraft Establishment; and synchros.

The guided weapons division showed an angular accelerometer, for use either as a special feedback element in servo systems or as a measuring device; a vibration-proof multicontact rotary switch for use under conditions in which leaf-type switches and relays were unreliable; and an adjustable lap hydraulic control valve, which helps overcome the difficult production problems normally associated with small precision hydraulic valves.

The exhibit of the British Thomson-Houston Co., Ltd., included a transistor self-balancing pyrometer, which compares infra-red radiation from a hot body with that from a standard lamp and is capable of recording temperatures from 150°C. upwards; and, of considerable interest, an electrostatic dust monitor, providing a means of measuring the dust concentration of flue gas.

Battery operated transistor vibration measuring equipment was also on show, as well as the demonstration of electro-luminescence of single zinc sulphide crystals, cold spot control of fluorescent lamp efficiency, and development of phosphorescent positives from photographic negatives. A wear scar planimeter for research into the effect of clearance angle on the life of milling cutters was also seen as well as a low-voltage X-ray set for polythene radiography, and apparatus for dielectric measurements on fluids at micro-wave frequencies.

Frequency Monitor

An automatic frequency monitor, designed to measure frequencies between 10 c/s and 20 Mc/s within ± 1 part in 1 mill. was a feature of the Cinema-Television Ltd. stand. A decimicro second chronometer and precision interval timer were also shown and two new 'Cintal' counting equipments of very recent development.

Numerous new types of thermionic valves, cathode ray tubes and semiconductors were seen on the stand of the General Electric Co., Ltd.; while this Company's research laboratories had a further display of this type of device and their applications. Among these was a photoelectric high speed recording telepyrometer capable of recording the temperature of molten glass between 900°C. and 1,200°C. with an accuracy of ± 1°C.

Seen on the Metropolitan-Vickers Electrical Co., Ltd., stand, was an electron microscope having a resolving power of 15 ängström units or better. Electron irradiation—useful, among other things, for increasing the storage life of foodstuffs and sterilisation of pharmaceutical products—was also demonstrated.

'Metrovac' vacuum coating plant, various diffusion and rotary pumps, diaphragm valves and vacuum gauges were also to be seen, as well as an electronic analogue simulator, mass spectrometer, and diffractometer. Also included was a display of klystrons for supplying radio-frequency power to linear accelerators.

Refractory metals—niobium, beryllium, molybdenum, tungsten, tantalum, and zirconium formed the basis of the Murex Ltd., exhibit, together with sintered permanent magnets; while Nash and Thompson, Ltd., showed a computer unit, B.N.F. coating thickness meter, scintillators, a water hardness monitor and various high-accuracy electrical measuring instruments.

From a paper to the Eastern Section, I.G.E., at Boston, on March 21.

The Development of the Lincoln Undertaking from 1949 to 1957

By D. W. AULT,
ENGINEER,
and
J. W. WILSON,
DISTRIBUTION ENGINEER,
LINCOLNSHIRE DIVISION, EAST MIDLANDS GAS BOARD.

AT vesting date the Lincoln undertaking represented in gas output 2.4% and in carbonising capacity 5.5% of the 101 undertakings vested in the East Midlands Gas Board. This is based on 12 months working immediately after nationalisation, when gas sales were 1,266 mill. cu.ft. and 78,518 tons of coal were carbonised.

In 1951, Lincoln had 16 new retorts in operation and a further 16 authorised in the first year after vesting date and due for completion in 1953. There were two relatively new gasholders in good condition with a combined capacity of 4.5 mill. cu.ft. and two 3.5 mill. cu.ft. per day sets of box purifiers one of which had been authorised shortly after vesting date and completed in November, 1950.

Since two of the gasholders were some distance from the main works on the far side of the railway, both the ring main compressors and the low pressure distribution system were fed through a long single 24 in. diameter outlet holder main. It has become obvious that at peak instant send-outs approaching 600,000 cu.ft. per hour the total pressure drop in the 24 in. main between the holder and the inlet compressors was over 4 in. W.G., and unless the holders were full, adequate pressures could not be maintained on the low pressure system by normal means. The works had, in fact, arrived at the position when it could comfortably make its peak outputs, but was unable to distribute them. An order had been placed, therefore, shortly after vesting date for a larger compressor of capacity 350,000 cu.ft. per hour which it was intended to instal adjacent to the existing machines.

Although the situation could have been kept in check by the use of this machine, its installation would have meant that two-thirds of the gas would have been distributed at high pressure and only one-third, and that with some difficulty, through the low pressure system. Quite apart from the inherent dangers of such a system, it appeared untenable economically and it was decided to evolve an alternative scheme.

Two Systems of Distribution

In 1952-53 there were two systems of distribution in existence: (1) A low pressure system from the outlet of two 24 in. diameter water sealed governors and (2) a high pressure ring main of 7 lb. per sq. in. working pressure.

The low pressure mains which radiated from the works to the south of the city were of adequate capacity for all existing and future proposed domestic loads for at least five to ten years. Fortunately the only major industrial consumer to the south was the Smith's Crisps factory which is only one hundred yards from the gasworks. It was known, however, that Harrison's foundry at North Hykeham were proposing to convert a large proportion of their process work from producer gas to town gas in August, 1954, and separate 12 in. and 10 in. diameter mains had already been authorised for this additional load, which was estimated at 5 mill. cu.ft. of gas per week.

The first 12 in. diameter section of the main was laid and temporarily connected to the 24 in. diameter low pressure feeder main outside the works and used to augment supplies to 700 houses on the new Skellingthorpe Estate. Eventually this main was to be connected to the already overloaded high pressure ring main.

The low pressure system to the north of the city consists of a 24 in. diameter main which splits into two 16 in. mains, one on either side of High Street, and these mains run into the centre of the town to the foot of the escarpment. From this point two 10 in. and one 12 in. mains radiate east and west, and from these mains, only three 8 in. diameter mains connect the uphill districts through the narrow and congested streets of the old part of the town.

The limitation of the low pressure system is this bottleneck of small diameter mains radiating from the High Street feeder mains, and this limitation affected not only the present problem but also the planning in the 1930's when the high pressure ring main was laid.

Maximum Peak Instant Demand

In terms of maximum peak instant demand, the low pressure mains were not capable of passing more than 290,000 cu.ft. of gas per hour through the system, with a pressure on the outlet station governor of 10 in. W.G., though in 1952-53 the maximum peak instant demand was between 590,000 and 600,000 cu.ft. per hour. This figure of 290,000 cu.ft. per hour was in fact impossible to obtain because of a number of the ring main governors back feeding gas into the low pressure system and limiting the sphere of influence of the station governor. Another factor which added to the difficulty of distributing gas to the low pressure system was the position of the gasholders in relation to the station governor. No. 3 and No. 4 holders were sited some 350 yards away from the station governor and the length of 24 in. diameter main between them carried not only the gas required for low pressure distribution but also for the greater part of its length, the gas to the compressors for the ring main.

At times of peak load and/or when the holder uncupped it became impossible to maintain adequate pressure on the inlet to the station governor, so that during these periods it was the practice to bypass the holders and pass 'make' gas direct to the low pressure governor. This had the effect of allowing only that gas required by the ring main compressors to pass through the long length of 24 in. holder outlet main and of cutting out the 4½ in. W.G. pressure drop.

In 1937 a high pressure ring main was laid, presumably because of the limitations of the low pressure system, together with the growing industrial loads in and around the town centre, and the development of the uphill area for housing requirements. This system consists of 1,000 yards of 14 in., 4,500 yards of 12 in. and 8,000 yards of 8 in. diameter steel main, protected externally with bitumen coated hessian wrapping. This ring main system circled the town centre and the proposed northern housing development areas at St. Giles and Riseholme, before returning to the works.

Three compressors supplied gas into this system. There were two 100,000 cu.ft. per hour capacity at three lb. per sq. in. Connersville machines driven by high speed steam engines exhausting to atmosphere and one 250,000 cu.ft. per hour 7 lb. per sq. in. Connersville machine driven by constant speed slip ring electric motor.

To supply gas from the ring main there were eight duplicate sets of Reynolds type of high pressure governors varying in size from four in. to eight in. Four of these governors were housed inside industrial premises near to the town centre, and supplied the gas requirements of six of the largest industrial consumers. The outlet of each of these four governors was also interconnected with the low pressure mains in the immediate vicinity, which augmented the low pressure district supplies, and, therefore, acted unnecessarily against the station governor in three cases.

The remaining governors supplied areas in which domestic consumers predominated, mainly in the uphill district.

In 1952-53 the large ring main compressor was already working at its maximum design pressure of 7 lb. per sq. in. at peak periods and permanent pressure recorders were fitted on the inlet and outlet of all the ring main governors.

Full Investigation

These charts gave the first real information of pressure conditions on the ring main, and confirmed the suspicions that the uphill housing development areas would very soon suffer serious pressure cuts because of the large group of industrial consumers, who all took gas from the high pressure system at points considerably nearer the gasworks.

As soon as this was realised a full investigation into the existing distribution conditions began. This included a pressure and load survey. Future building programmes were ascertained from the town and country planning and local authorities, and all existing industrial and commercial consumers were asked to give estimates of their possible future extensions and developments. These estimates included the proposed 5 mill. cu.ft. of gas per week required by the Harrison foundry conversion, in addition to the bulk supply of gas from Lincoln to the undertakings of Woodall Spa and Horncastle.

The estimated figures of future gas demand formed the basis of the reorganisation of both the distribution system and the works plant and auxiliary equipment.

The future demands were estimated over three periods:

(1) 1955, when the first stage of development would be completed.

(2) 1960, the intermediate stage for which reasonable forecasting could be made.

(3) 1970, the long term estimate which would not be so reliable, although it would provide a pattern for the future, and give valuable information as to what size mains should be laid.

After the investigations had been carried out, two main decisions were made:

(1) As a temporary expedient to overcome the peculiarities of the works connections, a temporary diesel driven booster was to be installed near the No. 3 and No. 4 holders so that sufficient gas from the holders for both the low pressure and high pressure systems could be supplied to the station governor and the compressor inlets.

(2) The laying of an industrial main which would relieve the present high pressure system of its industrial loads.

The following points were to be kept in mind:

(1) The future development of gas sales in Lincoln up to 1970 should be provided for so far as it was practicable.

(2) It would be necessary to renew the existing high pressure steel main within this period, and provision for its replacement must be borne in mind.

(3) The pressures required throughout the whole life of the new main should be kept as low as possible, consistent with the economic factors involved.

(4) The necessary expenditure should be spread over as long a period as possible.

The long term plan agreed upon was to replace the existing high pressure ring main in stages, with a large diameter medium pressure main operating eventually at a pressure of about two to three lb. per sq. in.

The first stage was to lay a 24 in. diameter main as far as Smith Clayton Forge to feed only the large industrial consumers en route, which would immediately relieve the existing high pressure system of between 120,000 and 150,000 cu.ft. per hour. To begin with, this system would only need a pressure at the works of 13 in. W.G.

Proceeding in this way, the largest compressor (7 lb. per sq. in.) would be adequate, until at some later stage the 24 in. industrial main would be further extended. Eventually the complete length of high pressure main would be taken out of use and the whole of the gas, other than that distributed through the low pressure system, would then be distributed through new boosters which would replace the compressors.

Compressing Plant

The following compressing plant would be needed for this first stage of reorganisation:

(1) One new high pressure ring main compressor (250,000 cu.ft. per hour at 7 lb. per sq. in.).

(2) A standby machine which would be provided by the existing machine which was in fair condition.

(3) A booster for the industrial main (200,000 cu.ft. per hour with a pressure increase of 10 in. W.G.).

(4) A transfer booster from the holders to the station governor (350,000 cu.ft. per hour with a pressure increase of 4½ in. W.G.).

(5) A booster to act as standby machine to (3) and (4) above.

(6) Three compressors for the bulk supply of gas to Woodall Spa and Horncastle undertakings (7,000 cu.ft. per hour each at 15 lb. per sq. in.).

Preliminary design considerations showed that the compressor house would consist of these eight machines. Apart from the standby machines, the total instantaneous running horse power would be about 300. There was, at that time, adequate space on the works side of the main line where steam and electric power were readily available, but since all three mains from the compressor house apart from the existing low pressure main, would leave the works on its eastern boundary near the gasholders, to build the compressor house here would mean crossing the main railway line with at least two new 24 in. and one new 4 in. diameter mains. There would also be long runs of main on the suction side of the machines.

Two Objections

There were only two objections to building the compressor house near the gasholders. One was staffing and the other was power, but it was eventually decided to run the compressor house with one full time shift operator, and electric power. In fact power presented little difficulty providing steam prime movers were not required and the availability of sufficient waste heat steam to generate all power required on the works made electricity the obvious choice. The need for providing diesel standby was duly considered, but in view of the proposal to instal a turbo-alternator, it was decided to adopt this as the main source of power and to utilise the grid as standby. The remote possibility that the alternator and grid might fail simultaneously remains, but this is considered to be a risk worth taking.

Fluctuations in Output

Since the compressor's duty was to feed domestic consumers almost entirely, it would suffer fluctuations in output from almost zero to full load, so a variable speed machine was essential. In view of the good condition of the existing electrically driven compressor, it was decided to move this to act as standby and by introducing a rotor resistance, a speed variation of down to 85% was possible. This has been found, however, to be quite inadequate for all normal use and if this machine is run, its output is regulated by bypassing through the relief valve. The outlet from the relief valve is taken into the inlet booster main to avoid any difficulty with overheating of the compressor.

The shortest route between Bracebridge gasworks and Smith Clayton forge, with easy access to other large industrial consumers, fortunately included large sections of open grassland which was ideal for mechanical excavation and economic main-laying, but this land was subject to an Act of Parliament, one of the objects of which was to preserve the land at all times as open common land and places of resort and recreation for the benefit of the inhabitants at large. Legal advice, then, had to be taken before approval to the route could be given.

On the route finally agreed upon about 5,000 yards of 24 in. main were laid, 80% of which was grassland, and the remainde

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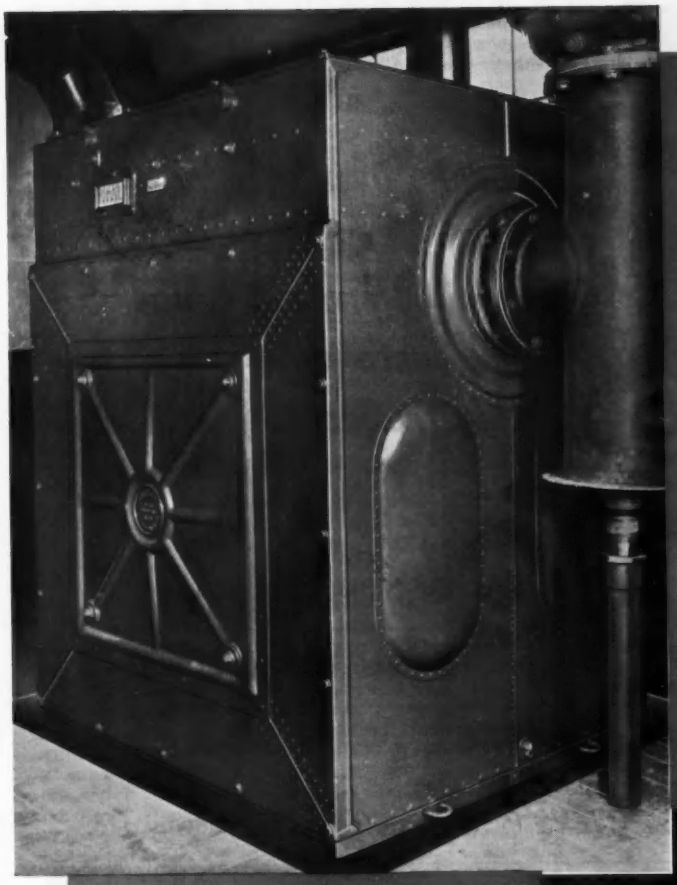

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in roadway or special crossings. There were four of these: (1) One pair of single railway siding lines, (2) South Delph Dyke 20 ft. wide, (3) double track main railway lines, (4) River Witham 81 ft. wide.

Both (1) and (3) were subject to normal wayleave agreements with the British Transport Commission and the main was laid under the railway lines in the normal way, without difficulty and on separate Sundays. An existing girder bridge structure carrying a 12 in. diameter steel main across the South Delph Dyke (2) was modified to carry the additional main, which was fabricated on site.

Three methods of crossing the River Witham (4) were considered:—

(a) To excavate by dragline and lay the main under the river bed.

(b) To lay under the river bed using a coffer dam.

(c) To construct a pipe bridge.

Since the River Witham is a navigable waterway a passage for river traffic had to be maintained, and excavation of 30 ft. depth in both river banks would have been necessary, so erecting a pipe bridge designed to carry two 24 in. mains, was considerably more favourable and was decided upon.

Manufacturing Plant Capacity

On commissioning of Lincoln IV, scheduled for early September, 1954, the carbonising plant would consist of 64 82-in. continuous vertical retorts with a nominal capacity of 8 mill. cu.ft. per day, but with an effective capacity for short periods of two to three days of probably 9 mill. cu.ft. per day. At the time the position was assessed in 1952, it was estimated that outputs of the order of 45.5 mill. cu.ft. per week would be reached in 1956-57 and since it appeared unlikely that such outputs would be reached for more than one week, the installation of additional peak load plant did not, at that time, appear to be pressing.

The first installation of 24 82-in. upwardly heated retorts was constructed in 1931 and the second installation of 8 lambent heated retorts was constructed in 1938. Both these benches of retorts were in the same house and used the same handling plant and so could, for all practical purposes, be considered as one installation. The two later installations of 32 retorts had sufficient capacity to meet the base load requirements and it was quite obvious that if new additional plant were to be provided, some form of peak load plant should be installed.

On the prices ruling at the end of 1952, the net cost of materials only for gas production in plant of the size involved at Lincoln were: Coal gas, approximately 3d. per therm, and carburetted water gas, approximately 8d. per therm.

The estimated cost of reconstructing Lincoln I retort bench within the confines of the existing steelwork and providing new coal handling plant linked with the new handling plant in Lincoln III and IV house, for which provision had been made during construction, and incorporating all possible improvements to bring it as far as possible into line with modern practice, was £160,000. On these figures, it was not possible to make out a case for the installation of carburetted water gas plant, even if the plant could have been obtained at no capital cost. Approximate tenders were obtained for two carburetted water gas plants with a combined nominal capacity of 3.5 mill. cu.ft. per day and the cost was about £140,000.

Decision Can Be Supported

Even though our expectation, that the proportion of base load gas at Lincoln would improve, has not materialised to any significant extent and oil gas plants are now available (the first oil gas plant went to work in this country in February, 1953), the decision to reconstruct the verticals can still be supported economically. Assuming the cost of the reconstruction and the cost of a similar oil gas plant to be identical which, in fact, favours the oil gas plant, capital costs can be neglected. The quantity of gas to be made in 1955-56 above that produced in the 40 retorts of Lincoln II, III and IV was approximately 170 mill. cu.ft. The actual cost of producing gas in the C.V.R. houses (labour and materials) was 5.95d. per therm. With an oil price of 9½d. per gal. in 1955-56 the cost of oil gas production (labour and materials) would have been 7.43d. per therm.

This reconstruction was planned on the tightest possible schedule by the Woodall-Duckham Construction Co., Ltd., but even so, the time occupied would be much more than the normal re-set. During the course of reconstruction, the bench was to be divided into two separate units by the omission of two retorts making two new units of 10 and 12 retorts to facilitate the subsequent repair programme. The programme, as laid down, required each half of the bench to be out of action for 27 weeks, both benches entirely cold for 20 weeks, and because of hopper, flue and gas main alterations, both Lincoln I and Lincoln II (a total of 32 retorts) to be cold for 17 weeks. In the final outcome, Lincoln II was not dropped cold, but held at scurfing temperatures since it was not possible to risk the loss of this gas making capacity for more than approximately three weeks in the summer period. It appeared that the latest possible summer in which this programme could be undertaken with a reasonable degree of safety was 1955 and the work was accordingly authorised by the Board to start in the summer of 1954 so that the first half of the work should proceed and the whole of the bench be cold during the summer of 1955.

By dint of strenuous efforts on the part of the contractors and many anxious moments on the part of the works' supervisory staff, the programme was carried through though it was necessary to light up the first half of the rebuilt bench in January, 1955, and then shutting it down cold again in the following June. The subsequent reconstruction of the eight retorts of Lincoln II in 1956 presented no great difficulty. In fact, they were reconstructed somewhat earlier than actually needed, but these retorts were due for complete re-set since this particular bench had not been repaired at all since it was put to work in 1938.

Almost the whole of the total steam production from the waste heat boilers at Lincoln, which amounted to 23,000 lb. per hour on full load, was used in small non-condensing steam engines, particularly the exhausters which exhausted to atmosphere. All process steam requirements were taken from the high pressure steam supply, and it was, therefore, clear that a drastic overhaul of these arrangements was needed. Consideration, therefore, was given to the installation of a turbo-alternator. To obtain the actual steam production figures upon which the size of the alternator should be based was very difficult, since the actual measurements of steam production at the works at this time gave quantities far in excess of theoretical maxima. Since this was due to the considerable retort leakage at the older installations, it was eventually decided to base the size of the turbine on theoretical considerations of steam production from the waste heat boilers which agreed with the Woodall-Duckham Construction Company's guarantee figures.

On the basis of a maximum steam production figure of 23,000 lb. at 120 lb. per sq. in. and 100°F. superheat and estimated pass-out steam requirements of 12,000 lb. per hour, the generating capacity of the alternator would be 900 kW. The possibility of installing two 500 kW sets to provide an element of stand-by was considered but ruled out on capital cost.

At a generating capacity of 900 kW the works would always be able to export power to the grid even after the electrification of all prime movers, but since the amount received for the exported electricity is related to the minimum export at any time during a month, it was decided to raise the capacity of the alternator to 1,000 kW. This will enable the export of electricity to the grid to be maintained during the very short periods of heavy electricity demand by reducing the quantity of pass-out steam from the turbine and making good the deficiency by low pressure steam raised in the old Lancashire boilers.

The installation of an alternator working on a voltage of 6.6 kV was almost dictated by the siting of the compressor house, which as the major user, is adjacent to the gasholders, and because of possible voltage drop, it was imperative to lay a high tension line to this compressor house. It is also an advantage to adopt the same voltage as the local grid distribution system to avoid difficulties which arise from voltage drop through the transformers.

Unfortunately, the alternator will not be commissioned until May, 1957, so that no firm figures of financial saving can be given. It was, however, estimated that after paying capital charges, the net annual saving assessed on electricity alone would be £3,100, and there is, from the national viewpoint, the small saving of the equivalent of approximately 800 tons of coal from our estimated annual export of 2,320,000 units of electricity.

At the same time the return as boiler feed water of approximately 12,000 lb. per hour of condensate from the turbine condenser previously blown to waste as exhaust steam, will save £240 per annum in water softener re-agents alone, but the saving in water is inadmissible as other developments described later will cut out the use of town water almost entirely.

Steam System

The installation of the turbo-generator made it necessary to revise the layout of the works steam services.

Since exhaust steam was used to a negligible extent on the works, the entire low pressure steam system was put in as new and nearly all appeared as a capital charge against the cost of the alternator. The existing high pressure steam mains have been retained, but it was necessary to provide new and larger main steam lines between the waste heat boilers and the alternator since the retort houses will now be exporting their total steam production instead of the net as previously. The new steam mains from the retort houses are 6 in. diameter and the old 5 in. diameter have been retained as stand-by.

The use of steam at 15 lb. per sq. in., which is the working pressure of the low pressure steam system, involved the fitting of West Taylor valves on each individual retort steaming connection to facilitate adjustment at this low pressure which is believed to be approximately 5 lb. less than the normal minimum recommended by the Woodall-Duckham Construction Co. Ltd., who advised us that it was not practicable to run the producer venturis at such a low pressure but that these should be retained on the high pressure system. As a result of some experiments by the Works Engineer at Lincoln, it was concluded that there was no insuperable difficulty in running at 15 lb. per sq. in. and the venturis have, therefore, been incorporated on the low pressure system.

The steam flow diagram shows that under peak load conditions, there is a deficiency of 2,000 to 3,000 lb. per hour of exhaust steam. This deficiency occurs only during the one or two peak winter weeks and will be made good initially by raising low pressure steam on breeze in the Lancashire boilers, but probably in the future, the installation of peak load plant in the form of oil gas or similar type of plant will provide additional quantities of low pressure steam.

Water System

Although it would have been possible to use raw river water for circulating in the turbine condenser, it would have involved extra extraction from the river and additional river water pumps, and probably additional efficient water filtration plant. Already there are heavy demands on the River Witham and its temperature is therefore high, so that any extra demand might have been refused by the River Board. A water cooling tower seemed to be the solution and was decided upon.

An afterthought was the extension of the water cooling tower to cool the gas condenser water with two objects in view: First, to provide a certain degree of extra capacity in the cooling tower to enable sections to be cleaned out and maintained, and secondly, to economise in town water, large quantities of which were being used.

The total quantity of town water used during the last completed twelve monthly period ending September, 1956, was 46 mill. gal. at a cost of £3,040, but on commissioning the water cooling tower and the re-organisation of the water services which is almost complete, no town water will be used except for domestic purposes with one exception. This exception is its use in the secondary condenser during the summer months.

The temperature of the water in the River Witham from which our river water pumps draw during July and August has been as high as 74°F. Meteorological data obtained from local R.A.F. sources show that the average wet-bulb temperature during August in the Lincoln area is 58.3°F.

If the optimum efficiency on the cooling tower is allowed for the re-cooled water temperature would be approximately 72°F. Both this and the river water temperature are too high for efficient cooling in the final pass of the secondary condenser, so arrangements have been made to admit town water into the last two bays of the secondary condenser to bring down the outlet gas temperature before the detarrers to 65°F. The admission of town water will be controlled and kept to a minimum by Drayton temperature regulated valves.

Ancillary Plant

To supplement the inadequate coal gas condensing capacity, which was only fulfilling its function because of the long run of the foul main, a 4 mill. cu.ft. per day vertical water tube condenser was ordered in 1952. It was intended to duplicate this condenser at a later date so that the two 1.5 mill. cu.ft. per day condensers which were worn out, could be withdrawn from service and to leave the 3 mill. cu.tf. per day capacity condenser in the stream to cover summer overhauls of the two 4 mill. units.

The then Technical Officer, Mr. Branson, suggested, however, that a secondary condenser should be provided rather than an increase in the capacity of the primary condensers. This idea proved to be sound as soon as the provision of extra exhauster capacity came to be considered since the installation of a turbo-exhauster on full load substantially raised the gas temperature (approximately 32°F. on full load) and would have had a serious effect on the efficiency of the detarrers and washers. A 9 mill. cu.ft. per day secondary condenser was ordered in January, 1956, and will be delivered in the near future.

The exhauster capacity which consisted of one 6 mill. cu.ft. per day and two older 3 mill. cu.ft. per day Connersville machines driven by Robey vertical steam engines, was giving considerable cause for concern. Although all machines were behaving well and giving every indication of reliability, it had always been the practice at the Lincoln works to run all three machines during the winter. The age of the two smaller machines caused rough running on full loads of 300,000 cu.ft. per hour, if any attempt was made to run only the 6 mill. and one of the 3 mill. machines, so it was quite impossible to carry the winter load on either the large machine alone or the two smaller machines alone. The works, then, has been running for several years with no exhauster stand-by in the winter.

Another cause for concern was the inlet and outlet mains to the exhausters, which were of steel. The outlet mains were overhead and the inlet mains underground, sited in a basement under the exhauster house where exhaust steam discharges, which made it almost impossible even to examine the inlet main.

The condition of the inlet main between the condensers and the exhausters was known to be in a very bad condition as early as the summer of 1953, but it was almost impracticable to replace this main because it was in one complete length and ran inside the exhauster foundation blocks. Although various schemes were put forward for providing a new overhead inlet main which could be connected up during an 8 to 12 hour shut-down in the summer, the capital expenditure seemed hardly warranted since the turbo-exhauster was already on order and the scheme included installing duplicate exhauster mains. Probably the risk involved in continuing to operate with the old inlet main in its poor condition was less than first supposed.

But our fears about the machines were not unfounded and this was shown during the winter of 1954-55 when, for no apparent reason, the six mill. cu.ft. per day exhauster pulled up. A detailed examination of the exhauster and its engine showed no apparent defects so the machine was put on load again, and ran quite satisfactorily. It was eventually concluded that the stoppage was due to a section of hard deposit or rust which had become detached from the inside of the outlet main and dropped on to the exhauster impellers.

Variable Steam Motor Unnecessary

Since the maximum coal gas production capacity under optimum conditions of making a high C.V. gas (approximately 520 B.Th.U. per cu.ft.) diluted with producer gas was between 9 mill. to 9.5 mill. cu.ft. per day, it was decided to instal a turbo-exhauster of 5 mill. cu.ft. per day capacity with electric drive, according to policy. To reduce capital outlay, a variable speed motor seemed unnecessary since the existing steam driven machines could be used during the low load summer period and the electric exhauster could be run during the winter when maximum steam efficiency was needed to keep up the electricity export. The steam exhausters would take over in the summer when the volume to be handled was below the surge line of the turbo machine and with lighter electricity loads there would be no difficulty in maintaining the electricity export at times when absolute efficiency of steam

usage is not vital. The turbo-machine is fitted with a Vulcan Sinclair scoop control fluid coupling for speed and vacuum control.

It may seem surprising that at vesting date no immediate attention was paid on a works of Lincoln's size, to the installation of electro-detarrers. The matter was given some thought, but, strange to say, the tar in the oxide was negligible and there was no indication at annual overhauls, of tar in the ammonia washers. With the inadequate condenser capacity it can only be attributed to the effectiveness of the long length of foul main as an atmospheric condenser. It was, therefore, impossible to substantiate any economic case for the installation of electro-detarrers and so it was decided to defer consideration for their use for some time.

The need for electro-detarrers, however, was finally brought about by an overall pressure drop throughout the works. Primarily due to a severe pressure drop across the purifiers, the outlet exhauster pressure at peak load was running at 56 in. w.g. which was causing a continual blowing of seals. Though steps were taken to increase purifier seals and various other seals, it was realised that more drastic steps to reduce overall pressures had to be taken. By replacing the Livesey's and P. & A. tar extractors by electro-detarrers, the outlet exhauster pressure could, it was estimated, be reduced by 5 in. w.g. at peak load which would at least give a breathing space until more attention could be paid to the purifiers.

By now it was fairly obvious that any manufacturing plant extensions at Lincoln would be in the form of peak load plant so that the coal gas ancillary plant stream could be stabilised at a maximum of 9 mill. cu.ft. per day as shown for the turbo-exhauster. Since the cost of two 6 mill. cu.ft. per day detarrers at £6,200 was only about £400 more than the cost of two 4 mill. cu.ft. per day detarrers and the extra cost involved in installing them including connections and foundations less than £1,000, Board approval was given to the installation of the larger plant. With a combined capacity of 12 mill. cu.ft. per day, extremely god detarring will be obtained on peak loads and even under peak load conditions one treater will deal with the whole make of coal gas at reduced efficiency.

When the second set of five purifier boxes was completed in 1950, the purifier plant at Lincoln consisted of two streams of five boxes, each box 30 ft. by 40 ft. by 6 ft. deep. The later boxes were all fitted with both disc and water valves.

With one major exception, the two streams were identical. The original boxes were arranged for normal downward flow through the oxide, but the second set was arranged for split flow, the gas passing in between the two layers and out at the top and bottom. The reason for changing the design was apparently an attempt to reduce the overall back pressure on the works, but it was overlooked that with the two streams working in parallel, the governing factor on back pressure was the pressure drop across the older set of boxes.

This difference in design was the cause of so many difficulties that the second set was converted back to normal downward flow.

At throughputs of about 8 mill. cu.ft. per day in the winter of 1955-56, the boxes were working at an R value of 38 with purifier pressures probably caused by the lack of electro-detarrers reaching phenomenal figures—13 in. w.g. across the second taker with the first and second box inlets open was quite common—so it was clear that some emergency action would have to be taken. It was decided to bring back into service an old set of four 30 ft. by 30 ft. boxes dating from 1908 which had been only used intermittently since the early part of the war and had been taken out of use in 1950. This plant could be used temporarily until new purifiers could be authorised and erected.

This was completed during the summer of 1956 at a cost of £6,500 and the boxes were back at work in November, 1956.

Coal Handling

All the coal stock except an emergency stock of about 2,000 tons is on the far side of the main railway line where 10,000 tons or enough for 4.5 winter weeks can be stored. There is no difficulty in handling coal into stock since a full train can be accepted into one of the sidings and unloaded by grab crane. When reclaiming coal, however, rail waggons must be loaded into empty rail trucks, which have to be shunted by British Railways across the main line into the works sidings. The current charge for doing this by British Railways is 15s. 7d. per waggon which makes the handling charges for coal out of stock particularly heavy.

The siting of the Strachan and Henshaw waggon tippler which is in the extreme corner of the works makes it impossible to bring in coal by road or use road vehicles for reclaiming from stock and precludes any possibility of introducing a ground level hopper and conveyor. The possibility of installing band conveyors across the railway to handle coal out of and coke into stock has been worked out by the Deputy Works Engineer. His scheme has now been developed.

The installation which is now under construction consists of two 24 in. band conveyors with a walkway across the main railway tracks and two inclined band conveyors on the far side of the railway. One of these band conveyors handles coal at 100 tons per hour from a ground level hopper near the coal stock directly into the top of the coal breaker and thence into the gravity bucket conveyor. The other band handles screened coke away from the coke plant (at the rate of 50 tons per hour) across the railway lines to a chute in the field from whence it can be placed to stock either by road vehicles or portable conveyors.

Coke can be reclaimed by way of a ground level hopper direct into a buffer hopper on the far side of the railway for loading into rail trucks, or alternatively, by feeding it into the coal reclaiming hopper, it can be put back into the coke plant for re-screening.

It is impossible to establish in terms of money, the advantages to be derived from this scheme. On the coal section, an annual saving in shunting charges of approximately £1,000 at current prices will accrue as well as a capital saving of about £9,000 which would otherwise have been necessary to provide a second waggon tippler to safeguard the supply of coal to the carbonising plant since the band conveyor by-passes the waggon tippler and could coal the carbonising plant direct from the coal store, if the tippler were out of action.

The other main advantage is for coke handling at times of peak demand in the winter, when it is not possible to meet all our orders for coke on current production. The reclaiming of even graded coke from the stock field presents considerable difficulty even by the use of portable equipment, but the new conveyor system will enable nearly all rail orders to be executed with properly de-breezed coke from graded stock piles in the field and will free current production for loading from the coke plant into road vehicles.

Liquor Disposal Arrangements

The high industrial gas load at Lincoln makes it necessary to discharge into the sewage works a quantity of liquor which approaches 2% of the dry weather sewage flow. The sulphate of ammonia plant which was erected in 1928 was in very poor condition and was only kept going by the constant attention of the works maintenance staff so that steps were taken to build up a close liaison with the sewage works with a view to regulating the discharge of liquor to the sewers (as required by the sewage works) to the best of our ability and to give them as much notice as possible of any unavoidable alterations in flow or change in quality caused by the break-down of the sulphate plant.

A new concentrated liquor plant was not ordered until November, 1954, and was finally commissioned in January, 1957. In the meantime the sulphate plant had finally become inoperable in August, 1955, but the happy relations which had been built up with the Borough Surveyor's staff and the River Board officials, made it possible to weather this period without serious difficulty.

A suggestion by the River Board's Fishery and Pollution Officer that some crude liquor might be disposed of to farmers to improve the final outfall effluent from the sewage works caused investigations to be made in 1956 as to local possibilities. A farmer who was already taking liquor for agricultural purposes at another undertaking, suggested that he should set up a distributing company, so a long term contract has been negotiated with this company for the sale of all liquor made at Lincoln works and loaded into its tankers for delivery to local farmers.

The Borough Engineer was kept informed of this development but should there be a breakdown in these new disposal arrangements either from weather or any other cause, a conditioning flow of between 50 and 100 gal. per hour of crude liquor will still be discharged to the sewage works. If the normal disposal arrangements do break down, the flow to the

sewage works will be stepped up gradually and the concentrated liquor plant put into operation immediately.

Future Proposals

From a study of the weekly output charts, peak weekly outputs are approaching the maximum output capacity of the works and if known future additional loads are taken into consideration it appears that additional plant must be provided by the winter of 1958-59 or 1959-60 at the very latest.

The possibility of the installation of a peak load plant of two mill. cu.ft. per day capacity immediately, followed by a second two mill. cu.ft. per day unit in three to four years' time is now being studied. To replace the somewhat doubtful old purifiers recently rehabilitated and to cope with the additional peak load gas, the installation of a set of tower purifiers with a capacity of eight mill. cu.ft. per day is being considered.

If in the long term, the peak load plant were to be expanded to four two mill. cu.ft. per day sets, the works will then have a total gas manufacturing capacity of between 16 and 17 mill. cu.ft. per day and a purification capacity of an eight mill. cu.ft. per day tower purifier plant and an existing seven mill. cu.ft. per day set of boxes. With the lower sulphur content of the peak load gas, this capacity would be considered adequate. The siting of both these items of plant, however, is one of considerable difficulty because there is no available site on this side of the main railway line with the exception of the disused gasholder tank. So far it seems possible that the tower purifiers will be erected over the disused gasholder tank which will be filled in and the peak load plant will be built in the gasholder field, but such sitings are by no means final.

No. 1 gasholder is at present out of use since its pressure of 5 in. W.G. when 'cupped up' and its small capacity make it unsuitable for use on the town. The holder is not conveniently placed for connecting to the existing booster system so it is to be taken out of commission for examination and major overhaul this year and may be used later as a relief holder.

Gas in France

'NEW ADVANCE IN SALES'

A NEW advance in gas sales in 1956 was how most of the French Press commented on the first known results of last year's operations of Gaz de France: 3,400 mill. m³ (120,000 mill. cu.ft.) corrected to 4,200 cal (440 B.Th.U. per cu.ft.) against 3,100 mill., states an editorial in the February issue of the *Journal des Usines à Gaz*. The percentage growth, of the order of 10%, is particularly to be noted. It is the first time for a long while that such rapid progress has been recorded. From 1950 to 1955 the rate of variation between one year and another has oscillated between 1.8% for 1952-53 and 5.3% for 1953-54, and the average rate of annual growth has been about 3.3%.

The year 1956 was evidently somewhat exceptional. The mean temperature was relatively low and the month of February particularly rigorous. But the low temperatures were not solely responsible, and the growth of sales must in all justice be partly attributed to the propaganda pursued by the industry in the Press, by poster, and in exhibitions. This effort bore its fruits and the public incontestably appreciates more and more the services rendered by gas, the comfort it gives in kitchen, bathroom, and wash-house. The proof of this is seen in the continued increase in the number of consumers; the increase in 1956 was around 100,000.

It is not without interest to cast an eye over the variation in the quantities of raw materials used and the volume of gas purchased. These figures in themselves give an idea of the transformation which is coming over the gas industry. While the tonnage of coal used shows only a relatively low increase, 6.4%, that of the quantity of propane used, that is to say, by cracking or by admixture exclusive of that distributed direct, is 38% and of other petroleum products 6.6%.

These increases are the more spectacular when seen against the relatively modest figures for previous years; they show that in the economic climate of 1956, that is, before the Suez crisis, the production of gas from petroleum products was developing at a great pace while the gasification of coal was progressing only very moderately.

The volumes of gas purchased increased by 19.5% for coke-oven gas, 27.5% natural gas and, a figure eloquent by itself, by nearly 80% for propane distributed by pipeline. And Gaz de France does not yet purchase more than one third of the production of the refineries!

This picture, however roughly drawn, explains, among other things, the diversity of gases supplied to the consumer, a diversity which would have daunted the operators of former times, but which must be accepted in the paucity of energy supplies which today confronts France, which must not neglect any of the resources available to her.

Such a diversity underlines the interest of the studies which have been pursued for several years by the Direction of Research and New Techniques on the interchangeability of gases. It underlines also the necessity to direct the construction of appliances for the utilisation of gas towards a greater flexibility, to permit them to burn without difficulty gases with characteristics extended over wider limits. The problem would have more chance of being easily resolved if constructors would take as a point of departure not, as they do today, apparatus designed to operate with town gas, but apparatus directly designed for natural gas. That is the position in the U.S.A. where natural gas has taken the place of manufactured gas. There seems no reason why it should go otherwise in France.

Universal Decimal Classification

A COMPLETELY revised edition of the universal decimal classification abridged schedules (with introduction and alphabetical index) published by the British Standards Institution in 1948, has been issued. B.S. 1000A—abridged—English edition—presents several important new features which should commend themselves to the steadily increasing number of library and other classifiers who depend on B.S. 1000A as the only complete English edition of the U.D.C. at present available.

The edition is bound in cloth-covered stiff boards, with coloured dividers (for quick reference) between the three main sections—introduction, tables, and alphabetical index.

Preceding the general introduction, there is a new note on the Dewey D.C. and U.D.C. explaining the resemblances and differences between these two related systems; and the general introduction itself has been recast as a concise guide for the less experienced classifiers and as a simple explanation as possible for the uninitiated and curious.

Equally important is the freshly compiled alphabetical subject index, which now runs to well over 20,000 entries, as against some 2,000 in the 1948 edition.

In both the main and auxiliary tables, the terminology has been extensively revised, and significant 'extensions and corrections to the U.D.C.' authorised to date have been incorporated. Though slightly extended, these abridged tables are still about one-tenth of the length of the full edition; they are therefore sufficiently detailed for most general use whilst providing the essential 'background' for specialists to use in conjunction with any appropriate sections of the full edition already published as B.S. 1000, or available in French and/or German.

Copies of this document may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Price £2 2s. (bound) and £1 15s. (unbound).

Industrial Hygiene

A CONFERENCE on instruments used in industrial hygiene organised by the British Occupational Hygiene Society, will be held in London on April 16 and 17; it is open to non-members of the Society on payment of a registration fee of £1 1s. which entitles them to receive a copy of the proceedings. Those who wish to attend should write to the Hon. Scientific Secretary, Dr. D. Turner, M. R. C. Laboratories, Holly Hill, Hampstead, N.W.3.

Introductory papers on statistical and clinical aspects of the subject will be read by Mr. R. C. Tomlinson, of the National Coal Board, and by Dr. P. Lawther, of the M.R.C. Group for Research on Atmospheric Pollution.

Photograph by courtesy of British Titan Products Co. Ltd.

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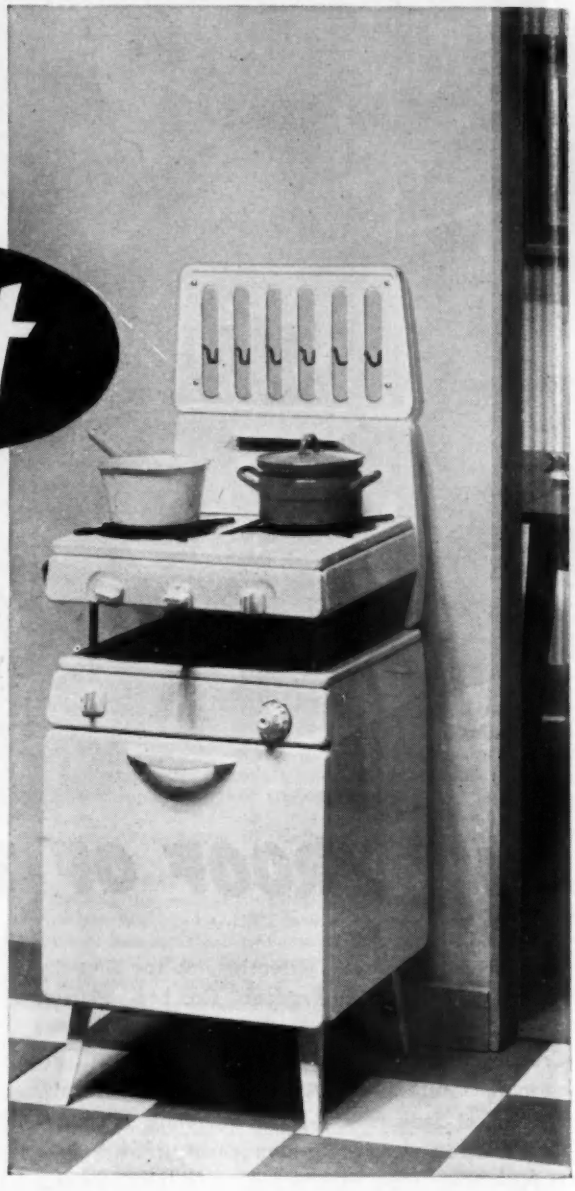

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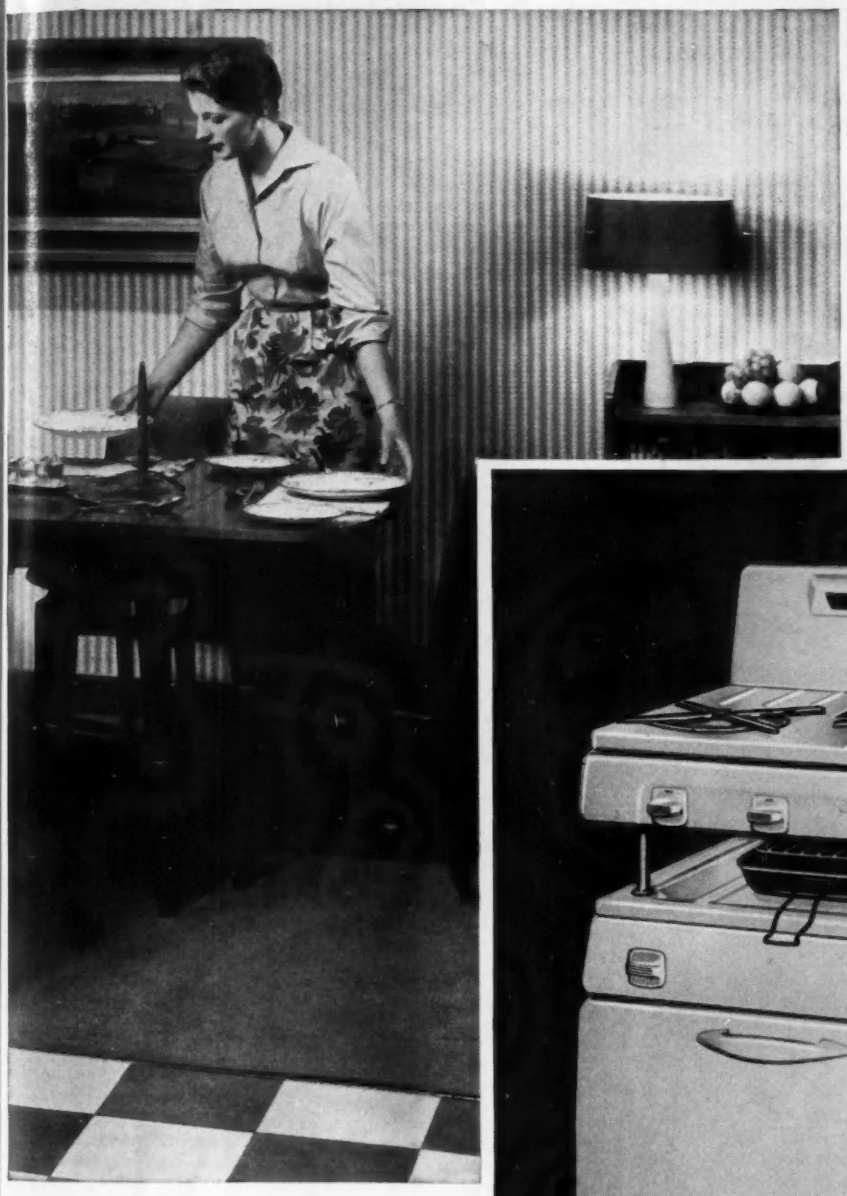

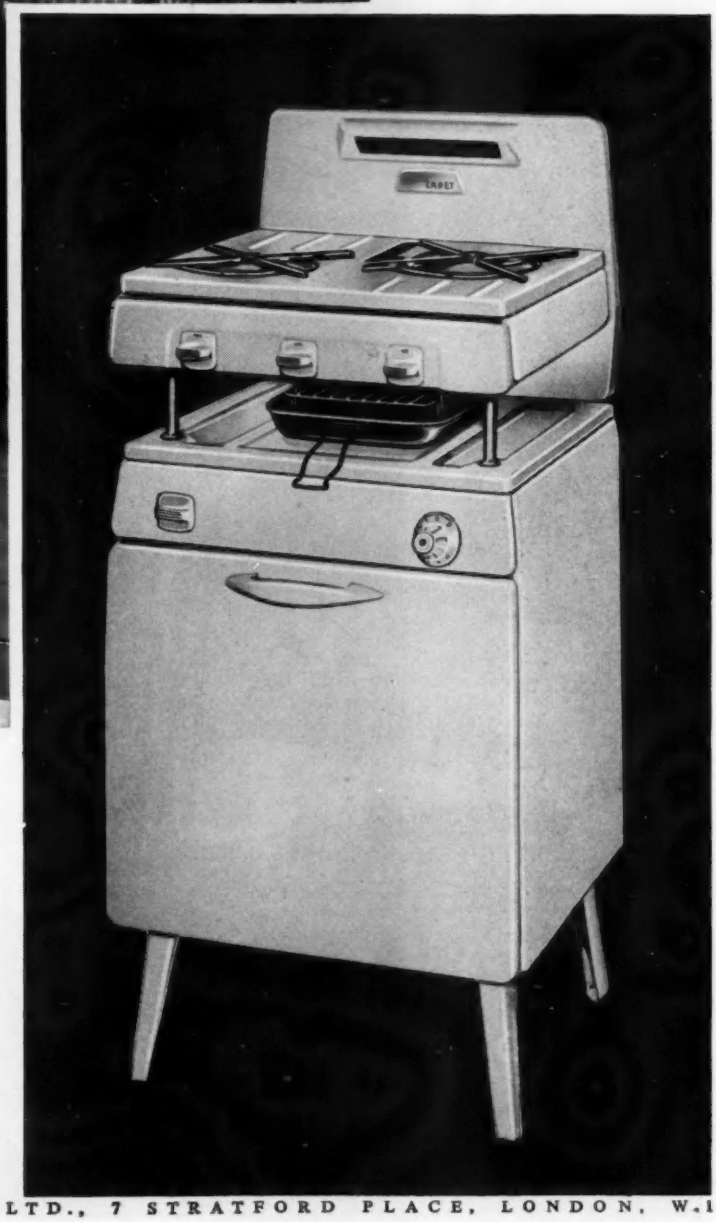

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From a paper to the Scottish Western Junior Gas Association, February 8.

Corrosion Control

By GEORGE B. SCOTT, A.R.T.C., Assoc.M.Inst.Gas E., Grad.I.Mech.E.
LANARKSHIRE DIVISION, SCOTTISH GAS BOARD.

In dealing with underground pipes, corrosion may be caused by one of two conditions, soil corrosion, from the corrosive action of soil water, and electrolytic corrosion, from stray electric currents. Regarding the former it is sufficient to say here that the moisture in the soil contains dissolved oxygen and traces of carbon dioxide. This acid solution combines with the metal to form soluble ferrous carbonate. The oxygen then converts the soluble iron salt into ferric hydroxide and liberates carbon dioxide, which is again free to attack the iron.

The latter condition is probably worthy of greater consideration, and may be compared to an electrolytic cell in which are two dissimilar metals in the presence of an electrolyte. One of these, forming the anode, will be corroded and the other, the cathode, will not.

Keeping in mind that the subsoil is never completely free of moisture, soil corrosion will always be active, whether it is due to the proximity of man-made structures, or the galvanic action of ashes, cinders, or certain types of clay. The importance of galvanic action, as opposed to that of stray electric currents, cannot be overstressed, and many known cases of extreme corrosion have been due to it. Carbon is cathodic to iron, and hence, in the presence of electrolyte, corrosion of the pipe will take place.

Cast Iron Resists Better

The evidence of experimental investigation is in favour of the generally accepted view that cast iron resists corrosion better than steel, and with sand cast or sand spun pipes this may largely be due to the foundry skin formed at the point of contact between the molten metal and the silicious sand of the mould.

Corrosion will obviously take place more rapidly where the soil is very damp, and where the earth contains other metals, most of which will be cathodic to iron. Some of these may be anodic to the pipe, and in soils of differing salt concentration there may be an internal or localised flow of current from the area of high salt concentration to the area of low salt concentration. The area of high salt concentration is where corrosion is greatest. Much trouble, too, is caused in large towns by the proximity of tramways or electric railways where the current is returning to its source by way of an earth. Here, these currents may find an easy path by entering a gas main at one point and leaving it at some remote point near the power station or junction box. At the point of entry the pipe is protected and at the point of exit there will be rapid corrosion.

To overcome corrosion there appear to be three courses open, (a) the use of non-corroding metals, (b) the removal of the causes of corrosion, and (c) the provision of protective layers; there is also a fourth course, cathodic protection, which will be discussed later.

The use of non-corroding metals is clearly the complete answer to the problem, if we can find a metal which is sufficiently strong and in such quantities as to be practical. Non-corroding metals are in two categories, (1) the noble metals, such as gold, silver and platinum, which do not undergo any chemical change, except under very drastic conditions, and (2) metals or alloys which form a resistant oxide film, such as aluminium, chromium, cobalt and tungsten. Pipes from such metals would not be practical, but it is interesting to note that the non-metal silicon has non-corrosive qualities and it is possible to manufacture a steel containing varying percentages of silicon. This steel, however, is highly ductile and is unable to withstand mechanical shock or changes in temperature.

To remove the causes of corrosion where the main causes are water and oxygen is impossible when dealing with underground structures. Gas mains are laid at depths varying from 2 to 5 ft. under normal conditions, and moisture is present at all times. The amount of moisture will be dependent on the type of subsoil, and, therefore, strata which tend to hold moisture must be viewed with suspicion.

Provision of protective layers may seem to be too general a statement, but it is applied to everything metallic which we try to protect, and can be grouped into:

(1) Painting, which is the recognised method of protecting metallic structures from rust above ground, and the main reason for doing so is cheapness and ease of application. The effectiveness of paint depends mainly on the manner in which it is applied. The surface must be perfectly clean, free from greasy oil or moisture, and all scale and rust should be removed. The best method of cleaning is by acid pickling, and it need hardly be said that all the acid must be thoroughly removed before applying the paint. The paint itself provides an impervious coating on the surface of the metal, and generally consists of the four constituents; the drying oil, which in the atmosphere becomes converted to a solid film; the drier, which acts as a catalyst for accelerating the drying of the oil; the pigment, which strengthens the film of the oil and gives colour; and the thinner, which gives the paint the correct consistency for application.

(2) Bituminous coatings, which are particularly suitable for cast and spun iron mains. The essentials for such coatings are toughness and durability. They must be completely waterproof and strongly adhesive to the metal. They must show no tendency to run when exposed to the warmth of the sun, nor to flake off in cold weather, and must be free from cracks, blisters, and be able to withstand rough treatment without 'chipping.'

(3) Cement coating was tried many years ago, by spraying the cement on to the pipe. It very probably afforded a good protection to the pipe, but the method has serious drawbacks. It is doubtful whether the coating could stand up to the handling from the works to the site, and, secondly, there is no effective method of applying the cement *in situ* to the joints. There is also a likelihood of carbonaceous matter being present which will act as a metal and cause corrosion by galvanic action.

(4) Protection by wrapping has, for many years, been employed with considerable success in the protection of steel mains and service pipes. It consists of a suitable fabric impregnated with a mixture of protoparaffins and inert substances, such as talc, but contains no rubber, resins or other unstable substances. Unlike bitumen, it never hardens, cracks or polymerises, but remains permanently plastic under all temperatures between 14°C. and 70°C. It is unaffected by vibration and is resistant to electrolytic action, but is not a complete antidote for corrosion. Since it can be applied on site after the joints have been made and tested there is no need to interfere with it for any reason after application.

Underground Steel Services

Tests as to the efficiency of such wrappings show that a length of steel pipe covered in the manner just described, after immersion in an aqueous solution of 20% hydrochloric acid at 68°F., was unaffected after 50 hours. The wrapping was equally effective against solutions of alkalis, such as potassium hydroxide and ammonia, and after testing in brine over a period of four days, a test piece showed an electrical resistance of 2 mill. ohms per sq. ft. of covering. These fabric wrappings are, therefore, particularly suitable for underground steel services, and extensive use is made of them.

Cathodic protection is not new, but was introduced in

America about 25 years ago, where it is used extensively by many major pipe line companies for both oil and natural gas.

The basic principle of cathodic protection is to realise that corrosion will occur for the reasons given, but if we could arrange it so that something else corroded, leaving the pipe intact, then any capital cost involved in doing so would be amply repaid by maintaining the new state of the metal. The fact that the pipe is anodic to the surrounding soil is the basic reason for corrosion so the solution is to make the pipe cathodic to its surroundings. This is what is known as cathodic protection. In other words, the corrosion is transferred to something else, and this can be done by two different methods:

(a) *The sacrificial anode method.*

Since it is an accepted fact that corrosion will occur an anode of suitable material is installed which is sacrificed to save the pipe line. This anode must be of a material which has a high electro-chemical voltage to iron, such as zinc, aluminium or magnesium. A slab of material is buried at a distance of about 10 ft. from the pipe and is connected to the pipe by a single insulated wire. The degree of protection attained is analogous to the current flow between the anode and cathode, which is proportional to the amount of moisture in the soil. Thus, in dry weather, when corrosion is at a minimum, very little current will flow and no wastage of the anode will occur.

Of the three materials mentioned, magnesium has for some time been recognised as the most desirable for use in cathodic protection installations, because it combines a large storage capacity for electricity and a high potential or driving voltage, both of which are desirable characteristics when the anode is to operate galvanically.

(b) *The impressed current method.*

In the first method discussed, the electro-chemical voltage difference between the anode and the pipe line is the important factor, but in the impressed current method, this driving potential is applied externally from some form of direct current supply. It can be seen from consideration of the simple cell that, if the negative pole of this current supply is connected to the pipe, and the positive pole to an artificial anode buried at some distance from the pipe, current will flow from the generator to the anode, thence by earth to the pipe, along the pipe and back to the generator. Thus, the artificial anode will corrode, and the pipe line will be protected. This method is preferable and is employed wherever possible, because the ultimate requirement is a source of electric power which is more cheaply obtainable from the mains than from an electro-chemical source. There are many cases, however, where the mains supply may not be available or peculiarities in the physical layout of the structure involved makes the use of this method impossible so that the use of sacrificial anodes is advantageous.

The material used for the anodes need not be active in the sense that magnesium is. Scrap iron was originally used, but the use of graphite anodes is finding favour. These are made in sizes from 2½ in. diameter by 60 in. to 6 in. diameter by 72 in. The most common source of power is a transformer/rectifier, which has the advantage of being robust, efficient, static in operation and requiring a minimum of maintenance, but it is dependent on an external source of A.C. power, and, when this is not available, other means have to be used, such as unattended generator sets, windmill generators with batteries to cover windless periods, and, more recently (and comparatively untried), thermopiles operated by any locally available fuel.

The cost of the cable is a major factor in the installation of a power fed system of cathodic protection, since it is normally necessary to run the cable for the full length of the pipe line. Such cables are troublesome to maintain, because they can easily be damaged by ground subsidence or by careless excavation on the part of other workmen.

The length of single pipe line which can be protected by a single unit depends on local conditions, but an average length might be one mile. The current requirements depend largely on the surface area of bare metal on the pipe, so that the most satisfactory method of protecting metal surfaces from corrosion is by a combination of a good coating and cathodic protection.

Unfortunately, the science of applying efficient cathodic protection is not one which can be set down on paper. Each individual problem can only be solved by the application of electro-chemical principles together with the flair and experience of the corrosion engineer.

Generally, the local distribution engineer can tell whether a district is corrosive or not from existing pipe lines. Where corrosion is expected to occur, or where soil surveys have shown the soil to be of a corrosive nature, the application of cathodic protection can be considered as an insurance against corrosion. For a cheap and reliable installation on small diameter pipe lines, the use of applied current protection can be discounted immediately, because the cost of the cable to carry the current is prohibitive. So we must rely on the magnesium anode method in such cases.

As was previously explained, stray currents passing through the earth are capable of causing damage to pipe lines. This also applies to the currents generated in the application of cathodic protection. In dealing with stray currents, it is the task of the engineer to avert the damage caused to the underground pipes in his care, but it is also his responsibility to prevent damage to all other structures in the vicinity by the action of his cathodic protection systems. It is quite wrong to assume that current flow is confined to that part of the earth between the anode and the cathode or the pipe line. These currents will flow symmetrically from the anode in varying degrees and this will depend upon the proximity of any other structure which can act as a cathode. This other structure will, therefore, collect current over part of its surface and discharge it from another part and so suffer corrosion at that point. A pipe line which is laid parallel to the anode bed, and in close proximity to it, will be in great danger of collecting currents, though if two pipe lines cross one another at different depths, it is not so serious, but corrosion will occur. Some of the currents flowing from the anode bed to the protected line will collect on the unprotected line, flow along it, and be discharged at the crossing via the earth to the protected line. Corrosion will, therefore, occur on the unprotected pipe at the crossing.

The solution to this problem may be found by locating unprotected pipes before the installation of a cathodic protection scheme, and it may be possible by placing the anodes away from existing lines, to minimise the effect of interference to negligible proportions. If, however, this is not possible, another remedy is to bond the lines together so that the current will return from the unprotected line to the protected line by an easy passage, and corrosion will not occur. In fact, a certain amount of protection will be afforded to the foreign pipe, which is dependent on the amount of current flowing. This current can, of course, be controlled by inserting a resistor in the bonding link.

DISCUSSION

Mr. A. Walker, Distribution Engineer, Alloa and Stirling Group, said that emphasis had been placed on mains. Was it not considered that protection should be extended to services? Much could be done by the care and proper wrapping of services. Since water and oxygen acting together were the two causes of corrosion, if they could cut out the water by drying the gas they would cut out their corrosion problems. The G.P.O. had to a certain extent been co-operating in his area in making sure that there were no stray currents going through from cables to mains. It was important that the Gas Board should co-operate with these other services. Class C pipe was a much superior class of steel pipe than they had been using hitherto. **Mr. Scott** agreed that although it was a dearer class of pipe it did yield results.

Mr. D. C. Moore, Greenock, referred to wrapping and the need for great care. He also complained that hessian in wrapping gave rise to bacterial growth, which had some effect on corrosion. Wrapping, he said, should have some asbestos face instead of a hessian face. He also endorsed the use of Class C pipe.

Mr. A. Mitchell, Uddingston, spoke of the importance of internal corrosion in steel mains. In the old Lanarkshire area before nationalisation there had been some considerable laying of steel main interlinkage between all the works. Now it had been found that most of these pipes were very badly corroded. There was no form of cathodic protection of them.

Mr. W. A. Green, Paisley, who presided, referred to copper for services. He said that, cost for cost, he thought copper pipe services were equal to Class C. Several members discussed the relative advantages of copper and steel, and the proceedings closed with a vote of thanks to Mr. Scott moved by **Mr. G. Campbell.**

Gas on the Continent

Abstracts from Recent Publications

Separation of Tar-Liquor Condensate in Horizontal Tank

HAVING passed over the heavy tar collector, the return flow from the coke ovens and the condensate from the coolers are passed into the funnel of the separator, which is located at one end of the horizontal tank. To keep the tar warm it passes through a wide capillary tube in the container, and is looped through the separator with its entry and outlet at the top. The tube rests on the bottom of the separator thus avoiding any leaks which might be caused by supports. Near the entry funnel, a special connection with the coke oven condensate pipe permits closing in case of repairs. A further advantage is the prevention of vertical turbulence, which might be caused by separate heating, and an improvement in the fluidity of the tar since the warming tube deals with the tar sump only and does not pass through the tar-water zone. At the other end of the container, at a point about a third of the way down from the top, the drainage connections of the preliminary sprinkler pumps are located. As the container is normally filled, the water supply on the top acts as primer, should the return flow from the furnace be interrupted for a short while to drain the heavy-tar tank. The overflow pipe is located on the top of the container. The overflow funnel of the ascending pipe can be set to regulate the tar contents in the container. The container has a diameter of 3m. and a length of 10m. Its contents are thus about 70 cu.m. Since

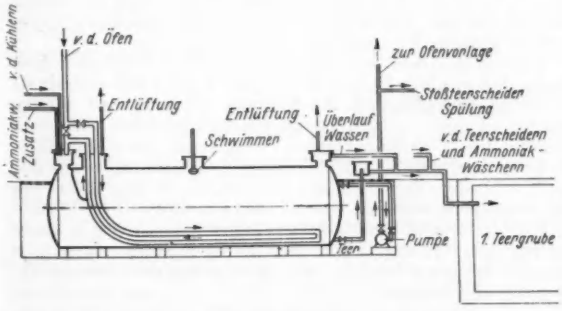


Fig. 1. Diagram of horizontal separator for condensate treatment at the rate of 80 cu.m. Diameter, 3m., length 10m.

v.d. Kuhlern	From the coolers
Ammoniakwasser-Zusatz	Addition of ammonia liquor
v.d. Öfen	From the ovens
Entluftung	Air exhaust
Schwimmer	Float
Uberlauf-Wasser	Overflow water
Teer	Tar
Pumpe	Pump
zur Ofenvorlage	To the preliminary oven supply
Stossteerscheider-Spülung	Rinsing of tar thrust separator
v.d. Teerscheidern und Ammoniakwäschern	From the tar separators and ammonia washers.
1. *Teergrube*	First tar pit

the pumps deliver 80 cu.m., the time of flow through it is less than an hour. It can further be regulated by increasing or decreasing the water contents. The plant has been working with success. The preliminary sprinkler water has been found to be free from tar while the water content of the tar which is being continuously and automatically drained is below 2%.

F. Eckert: *Das Gas und Wasserfach*, Vol. 97; No. 17, September 1, 1956, p. 753.

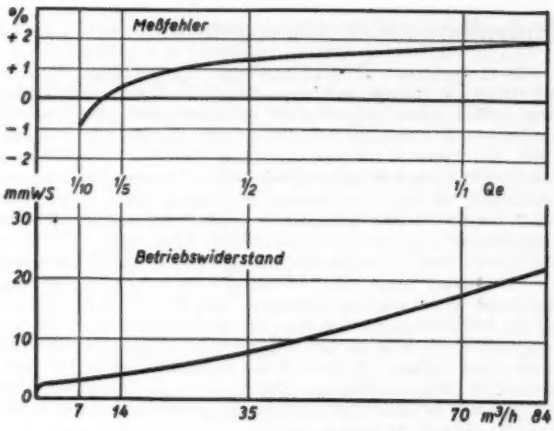
Spirally-guided Gasholders

On the occasion of the installation, by two German firms, of three spirally-guided gasholders in Sydney, Australia, the author gives a review of the principal types existing and on order on the Continent. He freely acknowledges that this type of holder has been used in Great Britain for almost a hundred years, but is new in Germany and France. According to him, the absence of staging required by these water-sealed holders provides a great economy in material and neither snow nor ice have impeded the working. Guide rails inclined 45° are passed over double rollers. When rising or descending these sections provide a turning movement. Galleries connected by steps and ladders permit the supervision of the lubrication, heating, etc., and lead right up to the crown. To prevent swaying of the ladders, their bottom end is fitted with guide rollers, while their top is attached to each upper border of the telescope by means of hooks. The rails are dipping into heated water troughs and transmit the heat to the rollers. The three largest continental holders are under construction at Alfortville near Paris. The first one, which is practically completed, holds 225,000 cu. m. This in a riveted holder, but the other two are to be welded. The holders, fitted with four lifts, have a diameter at the base of 77.6 m., with a total height extended of 71 m. and a weight amounting to 3,000 tons. The projected Australian holders are to have a capacity of 113,000 cu. m. each. All three are to be of identical construction and will work under the same pressure. The dimensions of the lifts, starting from the top are No. 1 60.15 m. diameter by 10.2 m. high; No. 2, 61.15 m. by 10.2 m.; No. 3, 62.15 m. by 10.2; No. 4, 63.15 by 10.5; tank, 64.15 m. by 10.56. The pressures thrown by these lifts measured in mm. W.G. are 17, 230, 290, 350; the number of guide rails is: 24, 32, 36, and 48. Total weight is about 1,800 tons. The prescribed conditions were: Steel to B.S.S. 15/48, and Australian Standard 33/D. No sheets under 5 mm. thickness were to be used. All inner and external edges of the sheets as well as heads of rivets were to be caulked. No packing was allowed. Delivery was taken at the constructing works. All three holders are expected to be in service during the summer of 1957. For future work, welded joints are to be exclusively employed and preference is to be given to flanged joints for the purpose.

M. Heisler. *Das Gas und Wasserfach.* Vol. 97. No. 21. November 1, 1956.

New Rotary Piston Gas Meters

Ever since their introduction, in 1930, rotary piston gas meters have enjoyed great popularity in Germany because of their solid construction and simple action. Since then, attempts have been made to introduce further improvements, especially in the reduction of slip to keep the meter within the prescribed standards of accuracy. The slip depends on the resistance of the counter and the size of the piston set. To obtain a minimum resistance or loss in pressure of not more than 25 mm. W.G., the most precise production methods are required as well as low tolerances in the distance between the pistons and their parallel position. This required special bearings and the greatest precision in the gearing with a view to reducing friction. Furthermore it was found that the smaller the quantity to be measured, the greater the error would be, which called therefore, for still greater accuracy in the working space. For these meters it was essential that with a rated load of 1/10 to 100% the accuracy should remain between +2 and −2% with illuminating gas and that even this tolerance should be avoided if possible. It was found to be impossible to accomplish this for meters measuring less than 150 cu. m. per hour NB. From a study of rotary piston blowers, however, built on the Roots principle and originally used for combustion purposes, small rotary piston gas meters with a rated capacity below 150 cu. m. per hour NB were designed and constructed. This again required great accuracy in manufacture and, so far, it has still been impossible to build meters with a range below 7 to 70 cu. m. per hour, but as a result of this development, rotary piston gas meters with a rated capacity of 100 and 70 cu. m. per hour are now on sale. They can be mounted horizontally or vertically, and can be connected by flanged couplings to the service. Their



Messfehler ... ... Error in counting
Betriebswiderstand ... ... Resistance to action

size is small, and they are easily mounted, and they withstand a pressure of 10 atm. Fixed to them is an indicator showing loss in pressure which indicates when cleaning of the measurement space and the apparatus is required. In the diagram the curves for error and resistance for an NB 70 rotary piston gas meter are shown. It is said that the meters have gained much popularity and are also being built in sizes from 150 to 200 cu. m. per hour NB. In this form they are used in schools, hospitals, office buildings, etc. Small gas sub-stations are also using them, applications have been found for them in oilfields and for measuring natural gas, and they have also been employed for measuring the air consumption of internal combustion engines.

D. Sack. *Gas-Wärme.* Vol. 5. No. 12. December, 1956.

NEW BOOKS

NOTES ON FOUNDATION ENGINEERING, West's Piling Construction Company

IT was probably the introduction of the vertical retort which intensified the gas engineer's interest in foundations. In common with developments in other industries, and indeed in heavy structural engineering generally, carbonising plant tends towards the concentration of big loads into small areas. These loads could be no longer safely or economically carried on a simple bed of concrete, even though this development took place when the use of Portland cement was well established. The gas engineer had to look back to the practice of other civil engineers who, with heavy buildings to support, had been compelled to examine those layers of sedimentary deposit which lie between the surface of the earth and its primeval crust.

Notes on Foundation Engineering, now issued by West's Piling & Construction Company, consists very largely of brief descriptions of some of the contracts carried out by them in this field, but it opens with an interesting and useful introduction to the subject as a whole. In spite of 'soil mechanics' the design and execution of foundation work is still very much of an art. But it is also a science, in the sense that sound judgment can be based only on accurate knowledge. Gone are the days when the examination of one or more trial holes a few feet deep were a sufficient criterion of the bearing qualities of the—as we prefer to call it—sub-soil. The requirements of modern highly-concentrated loads demand a thorough survey by bore-holes of the strata which lie between the top-soil and the hard rock, whether that of 'the permanent earth structure, resulting from the cooling of the original molten mass,' or the sufficiently stable and well consolidated sedimentary rocks which lie directly upon it. There is more to it, of course, than this; the other considerations are well set-out in this little book.

The weight of the structure may be spread out by means of footings or rafts over strata of low bearing capacity but there comes a point when the necessary area of such devices would make them too expensive and then the weight may be transmitted by piers or piles to a harder stratum below. Of course the main purpose of the book is to commend the Company's very interesting shell pile, but it sets out very fairly the features of other forms of the now almost universally used concrete or reinforced concrete pile, and justifies its commendation by sound reasoning which is summarised by Mr. A. G. Bird in his preface. There is a brief but adequate description which is expanded in detail in Chapter 2 with much practical information and some illuminating diagrams. It is, in short, a hollow pile which 'may be inspected (*in situ*) visually prior to the casting in place of the reinforced concrete core.'

The extensive selection of work carried out includes several examples of gasworks foundations, with some good data, but also of similar work in other industries which will be examined with interest in view of the increasing scope and diversity of structures in the gas industry itself.

This publication is to be recommended for a place among the text books. (Chapter 1 is indeed a nice little essay on the geological basis of foundation engineering.) It is modern publicity of the highest order in which not only are the relevant products recommended to the client but their scientific basis, together with that derived from an extensive practice, is laid frankly before him.

Total Moisture of Coal

THE revised British Standard, methods for the analysis and testing of coal and coke (B.S. 1016, Part 1:1957), 'Total moisture of coal,' incorporates the results of international discussion, and research work undertaken by the B.S.I. committee on solid fuel. Its companion standard, B.S. 1017—Methods for the sampling of coal and coke—is also being revised in order fully to maintain the link between the two publications. B.S. 1016 will now deal expressly with the analysis and testing of coal and coke, and B.S. 1017 with the collection and preparation of samples for analysis.

The standard will be published in separate parts, each dealing with a particular group of analyses. Thus it will be possible to revise any part with the minimum of delay and without having to issue a new comprehensive standard. Where a method for a particular group of analyses for coke differs widely from that for coal it will be published as a separate part, but where the modifications for coke are slight they will be given as separate sections of the same part.

B.S. 1016: Part 1 deals with the determination of the moisture in the coal 'as sampled.' Each of its sections relates to a sample of given particle size, and applicable methods are specified in sub-sections. Details of air-drying and reduction in particle size have been excluded, since they will be fully treated in the revision of B.S. 1017.

In the distillation method for the ¼ in. sample, toluene has been substituted for petroleum distillate of 150-180°C. boiling range, as it has been found that petroleum distillate can give higher results due, possibly, to the evolution of water of hydration from the mineral matter or to the decomposition of the coal at elevated temperatures. (A description of the apparatus used in this method has now been published as a separate standard—B.S. 756, Dean and Stark apparatus.)

B.S.I. Yearbook for 1957

THE yearbook for 1957 of the British Standards Institution contains, as usual, 400 pages devoted to a complete numerical list of the British Standards and Codes of Practice current on January 1, 1957. These total approximately 3,000. Copies of B.S.I.'s yearbook, which is an essential reference work to users of British Standards, have been sent free to all the Institution's subscribing membership, who may purchase additional copies at the published price of 15s., less members' discount. Non-members of the Institution may buy at the published price plus 1s. 6d. for postage and packing.

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A. FACER,
General Manager,

Wales Gas Board,
Pontypool Undertaking,
Gas Offices,
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APPLICATIONS are invited for the post of TECHNICAL ASSISTANT in Dumfries District Undertaking.

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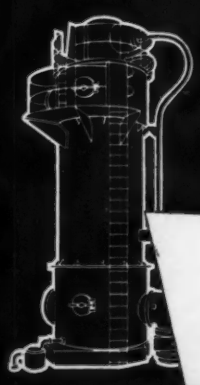

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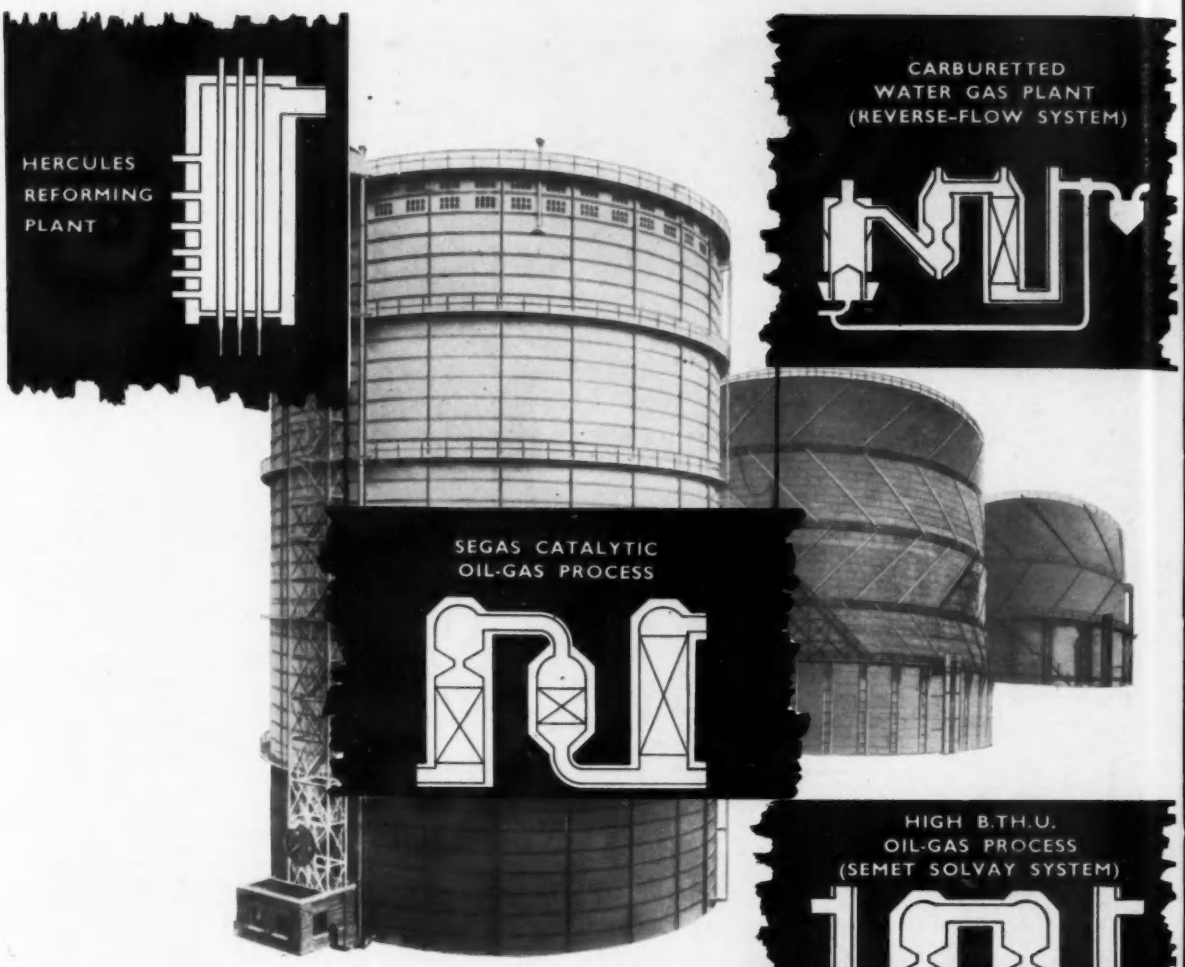

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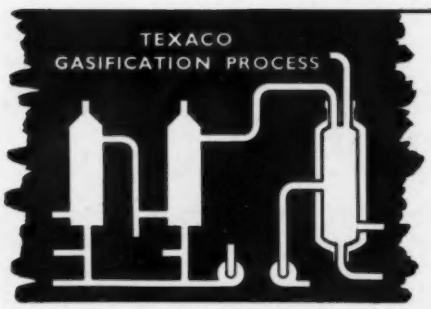

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